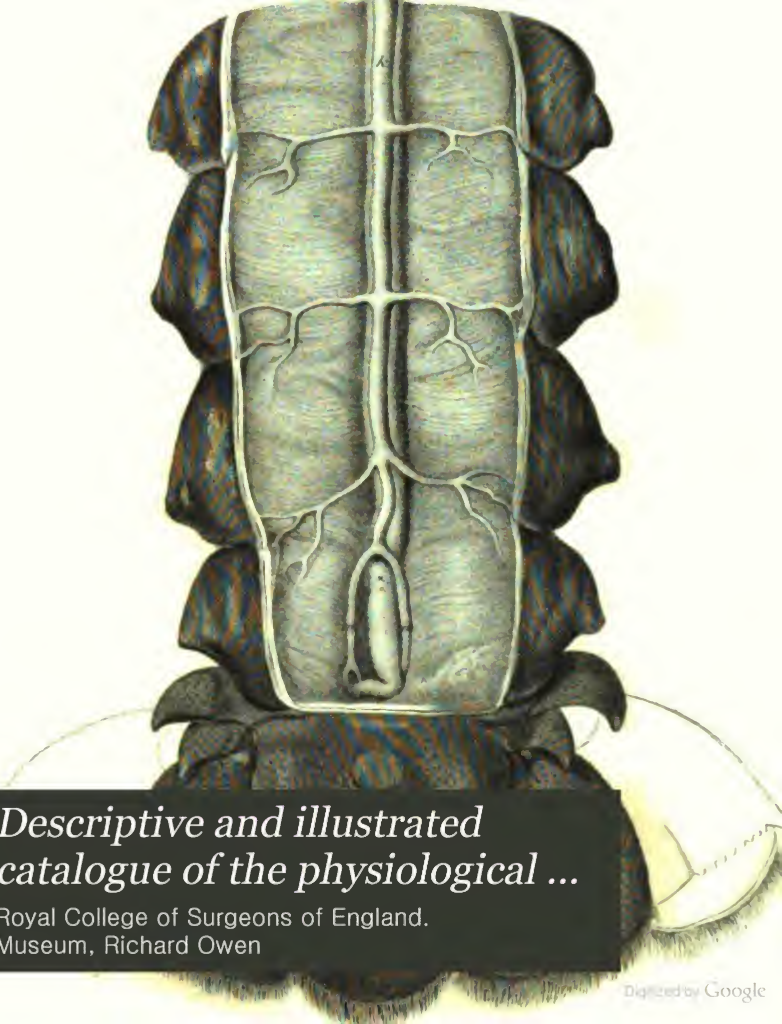

Descriptive and illustrated catalogue of the physiological ...

Royal College of Surgeons of England.
Museum, Richard Owen

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DESCRIPTIVE AND ILLUSTRATED CATALOGUE

OF

THE PHYSIOLOGICAL SERIES

OF

COMPARATIVE ANATOMY

CONTAINED IN

THE MUSEUM

OF

THE ROYAL COLLEGE OF SURGEONS
IN LONDON.

Vol. II.

INCLUDING THE ABSORBENT, CIRCULATING, RESPIRATORY,
AND URINARY SYSTEMS.

LONDON:
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ADVERTISEMENT.

THE present volume of the Physiological Catalogue is descriptive of the preparations belonging to the Absorbent, Sanguiferous, Respiratory and Urinary Systems.

The original arrangement of these preparations adopted by the Founder of the Collection, for the purpose of displaying the connexion and relations of the several structures and the successive stages of their development, has been followed as closely as the indications contained in the manuscript Catalogues would warrant.

The denominations of such specimens as are noticed in those documents have been verified or corrected, after careful comparisons, as well with the results of numerous dissections as with the descriptive writings of the most esteemed authors; and the unnamed specimens have been, by the same means, for the most part satisfactorily determined.

Each subdivision is preceded, as in the former volume, by introductory observations from the pen of Mr. Hunter, in which the physiological principles deducible from the variety of structures selected for illustration are briefly but clearly expressed, the laws which regulate the coexistence of the different systems in the same organism more or less fully considered, and the characteristic additions pointed out by which the organs at length attain the complex structure adapted to the necessities of the most highly developed forms in the animal kingdom.

The Introduction to the Absorbent System appears to be the only one of these valuable writings which Mr. Hunter has embodied in his printed Works; the greater part of it is contained in the chapter on 'Ulcerative Inflammation,' in the 'Treatise on the Blood'; the whole of which Work may, indeed, be considered as an extended commentary on the functions which the present and succeeding subdivisions of the Physiological Series are designed to illustrate, and many of the preparations therein alluded to are contained in this part of the Collection.

Mr. Hunter's researches on the Circulating System as it exists in the different classes of animals place him far in advance of the general knowledge possessed by his contemporaries on that subject, and he was led by the extent and accuracy of his observations to conclusions which have been fully established by some justly celebrated discoveries of the Comparative Anatomists of the present day *. Thus, having found in the Crustaceans, that the returning or venous blood was diffused through the body in extensive and irregular sinuses, Mr. Hunter was prepared to regard as less anomalous a corresponding absence of cylindrical canals for the transmission of the blood to the propelling organ in Insects. He had carefully investigated their peculiarly diffused and extensive respiratory apparatus; and, having a just perception of the relations subsisting between the aërating and sanguiferous organs, he does not hesitate to declare that their whole cellular system is

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* CARUS in his Treatise entitled 'Blutkreislaufes in den Larven Netzflüglicher Insecten,' 4to 1827; LUND in his 'Researches on the Circulating System of the Lobster, Isis, 1825'; and STRAUS DURCKHEIM in his 'Considérations sur l'Anat. Comp. des Articulés,' p. 345, have severally established the accuracy of the conclusions to which Mr. Hunter had arrived as to the nature and functions of the heart in the higher Articulata; and which he published upwards of forty years ago in his 'Treatise on the Blood,' where he observes, with respect to the use of the heart, "it is, in the most simple kind of single heart, to propel the blood through the body, immediately from the veins, which blood is to receive its purification in this passage, when the lungs are disposed throughout the body, as in the flying Insect. In another single heart it is intended to mix both the purified and the adulterated blood, and of course to throw it out to the body and lungs equally in this mixed state, as in the Lobster." p. 144.

permeated by the venous blood. This remarkable characteristic of the organization of Insects was not, however, considered by Mr. Hunter to be inconsistent with a determinate motion of their nutritive fluids: his appreciation of the harmony which pervades organic nature enabled him to avoid the error of denying them a circulation of the blood, or of supposing that there existed so great an interruption in the analogies of animal structures as must have resulted from a rejection of the dorsal vessel from their sanguiferous system.

His conclusions as to the nature of the dorsal vessel reposed not only upon the analogy which his extensive knowledge of the anatomy of the Articulate Animals disclosed to him, but also on its powers and actions in the living Insect, and on numerous delicate anatomical investigations in which he succeeded in injecting it from the surrounding sinuses*. In the series of preparations which precede those of the dorsal vessel the Founder of the Collection gradually leads the observer to the perception of its true uses and relations to the sanguiferous system. The development of this system is traced through the simple channels continuous with the alimentary cavity, which are excavated in the homogeneous parenchyma of the Medusa and Tapeworm; through the distinct and more complicated vascular system of the Annelides, in which the dorsal vessel begins to assume the arterial structure; until we arrive at the superaddition of an express pulsating organ and centre of the circulation in the Insect and Crustacean.

The heart is then displayed in all its modifications in the Molluscous and Vertebrate classes. The various forms of the superadded bulb in the heart of Fishes, and the different positions, numbers, and structures of the valves, are exhibited. The structure of the heart of Reptiles is then demonstrated; and here we have a gratifying instance of Mr. Hunter's accuracy in matters of anatomical detail. He ascribes two auricles to all the *Amphibia* of Linnæus, denominating them from this three-chambered structure of the heart *Tricoilia*; and the accuracy of this ascription has been proved by very recent researches, even as regard the Batrachian Reptiles, to which both Cuvier and Meckel in their latest Treatises assign the simple heart of Fishes*.

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* See No. 893.

In the selection, formation, and disposition of the preparations illustrative of the Respiratory function, the operations of the same master-mind and hand—so conspicuous in the preceding Series—are equally displayed. Not any of the leading modifications of this system have been omitted, and the several structures are demonstrated by the most delicate and successful anatomical manipulations. The injections thrown into the canals which meander through the delicate substance of the disk of the Medusa are seen to have filled the extreme meshes of the marginal respiratory reticulation. The numerous and microscopic tracheæ of the air-breathing Insect are exposed by equally successful dissections. The multiform aquatic respiratory organ is exhibited in the tegumentary tufts, internal sacs, and vascular plexuses of the Annelides, in the laminated and ciliated gills of the Cirripeds and Crustaceans, and in the laminated, tufted, pectinated, and tripinnatifid branchiæ of the Mollusks. The several modifications of the permanent gills of Fishes are then demonstrated, together with the analogous transient structures observable in the earlier stages of existence in some of this Class, as the external filamentary branchiæ of the higher organized Cartilaginous Fishes.

The permanent combination of gills and lungs in the lowest Reptiles formed one of the earliest of Mr. Hunter's published discoveries†; and this interesting condition of the respiratory system has naturally been demonstrated by him with peculiar care, and has been traced through all its gradations to a more perfect type*.

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* With respect to the Perennibranchiate Reptiles, Mr. Hunter, it will be perceived, still considered the apparently single auricle in these to be undivided; but an examination of the heart in a recent *Siren lacertina* has shown that the arterialized blood is returned from the lungs to a peculiar receptacle distinct from the great sinus and auricle of the veins of the body; and it is highly probable that the same structure obtains in the remainder of this division of Amphibious Reptiles. See No. 913 A.

† See Philosophical Transactions, vol. lvi. 1766, p. 308.

The progressive complication of the air-breathing organs of the Vertebrata is illustrated by an extensive series of preparations; and, where the analogy of structure ceases to be obvious to the eye from the minuteness of the subdivision of the air-cells, Mr. Hunter has carefully provided for the deficiency by causing accurate and beautiful drawings to be made from microscopical examinations of the recent structures†.

In the preparations of the Urinary Organs, with the description of which this portion of the Catalogue concludes, there will be perceived some important anticipations of modern discoveries. The accuracy of Mr. Hunter's ascription of a distinct renal organ to the higher Invertebrate Animals, has been confirmed by the analysis of the secretion of the so-called *saccus calcareus* of the Snail and other Mollusks, which is found to contain the uric acid‡. The retrograde injections of the tubuli uriniferi in the kidney of the Horse, &c., have been acknowledged by the best writers on this branch of anatomy[*] to have contributed in the most material degree to the elucidation of the complex structure of the kidney in the Mammalia: and Mr. Hunter in pursuing this mode of investigation, of which he was the inventor, did not confine himself to the Solipedous Quadrupeds, but succeeded in demonstrating the continuation of the uriniferous tubules to the surface of the kidney in one of the Quadrumanous Order. Not only have the more obvious differences which the renal organ presents in animals of different classes been displayed, but the varieties which it exhibits in the Mammiferous Series have been traced with a degree of perseverance and success which is truly surprising; and the philosophic spirit in which the researches of the Founder into the organization of animals were conducted, is perhaps nowhere more conspicuous than in the arrangement and illustration of this part of his Collection.

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* In the philosophical discourse on the *Pneumobranchiata*, which Mr. Hunter has prefixed to his description of the plates representing the Circulating and Respiratory Systems of the *Menopoma*, (p. 145.) there is throughout an attempt to discover *corresponding parts* under the disguises which they assume in different species from being arrested at different stages of development, and the branchial vessels of the Fish and Siren are thus traced step by step, losing their complex character as another kind of respiration is substituted, until they are reduced to the two aortæ which encompass the alimentary canal in the higher reptiles. Modern anatomists, in prosecuting this, the highest branch of anatomical research, have succeeded in demonstrating a similar but more extended series of changes in the Respiratory and Vascular Systems of the highest divisions of the Vertebrate Series, even in man himself; and the persevering application of the same principle in tracing the variations of the other systems of the animal organization tends daily to confirm the great truth which the Founder of the Collection had already conceived while prosecuting his laborious researches on the development of the Chick, viz. that the inferior animals represent the successive stages of development through which the more perfect pass in the progress to their allotted condition of organization. See note at p. iv. vol. I.

† See Plate XXVII.

‡ See the memoir entitled "Sur l'existence des reins dans les Mollusques," by Jacobson and De Blainville, *Journal de Physique*, tom. xci. p. 318.

[*] See Müller, 'De Glandularum secernentium Structura penitiori, earumque primâ Formatione,' p. 95. "Convertimur, priusquam proprias de renum structurâ observationes proferamus, ad præstantissima Huschkei observata," (Ueber die Textur der Nieren, Isis 1828, p. 560.),—nimirum Huschkeo ope antliæ pneumaticæ contigit, ductus uriniferos mammalium etiam, non modo in medullari substantiâ, sed per corticem ipsum ad superficiem usque renum, feliciter inde ex uretere replere, quod nemini hactenus successit. Hinc antiqua illa hypothesis de finibus ductuum uriniferorum, nullo dubio superstite, tandem dijudicari potuit." Müller afterwards observes, p. 98, "Eodem modo facta credo similia ex Equo præparata, in Museo Hunteriano Londinensi conservata, quæ Meckelio visa sunt. In aliis mammalibus ope siphonis nunquam ductus Belliniani replentur ex uretere."

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ABSORBENT SYSTEM.

"* AS I have ideas peculiar to myself respecting the mode of ulceration, and as those ideas are immediately connected with the Absorbent System, it will be proper to inform the reader what those ideas are; and I shall begin by observing what substances have been commonly thought capable of being absorbed.

"First, the absorbents take up extraneous matter, in which is included the common nourishment.

"Secondly, secreted, superfluous, and extravasated matter.

"Thirdly, the fat; producing leanness.

"Fourthly, they occasion a waste of parts, in consequence of which muscles become smaller, bones become lighter, &c. Although these two last effects were, perhaps, not expressly said to be carried on by absorption, either by veins, or any other system of vessels, yet we must suppose they were understood.

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* This portion of the MS. Catalogue appears to have been partially copied from the manuscript of the Work 'On the Blood,' see p. 439.

"So far the absorbents have been in general considered as active parts in the animal œconomy; but upon a further knowledge of these vessels we shall find that they are of much more consequence in the body than has been imagined, and that they are often taking down what the arteries had formerly built up in the natural growth of the body, becoming modellers of the form of the body while growing; removing whole organs, and also many diseased and dead parts, which were beyond the power of cure.

"As these vessels are productive of a vast variety of effects in the animal œconomy which are very dissimilar in intention, they may be viewed in a variety of lights, and admit of a variety of divisions. I shall at present consider them in two views only, viz. first, as absorbing matter which is no part of the machine; secondly, as absorbing the machine itself.

"In the first, viz. the absorption of matter which is no part of the machine, may be ranked, everything applied to the skin, the chyle, many of the secreted juices, the fat, and the earth of bones [*]; as also many substances which do not in the least affect the body; and many others that affect it materially, such as poisons. This kind of absorption is for the nourishment of the body, and also answers many other purposes; but, besides its salutary effects, it is often the cause of a thousand diseases, especially from poisons.

"In the second, we are to consider the absorbents as removing parts of the body itself, which action may be viewed in two lights; first, as immediately connected with our growth, and secondly, as arising from disease.

"In the first of this division, they are to be considered as the modellers of the form of the body; and if we were to consider them fully in this view, we should find that no alteration can take place in the original formation of many of the parts in the natural growth, but that the absorbents are the principal agents in it. This absorption I have called the 'Modelling Absorption.' If I were to consider their powers in this light, it would lead me into a variety of effects, as extensive as any principle in the animal œconomy, for a bone cannot be formed without it, the new osseous part cannot be added till some of the old is taken away; and the same holds good in many other parts. They are also removing parts unfit for the changes the animal goes through in its different stages towards perfection. A part which was necessary in one stage of life, but which becomes entirely useless in another, is thus removed. This is evident in many animals: the thymus gland is removed; the *membrana pupillaris* and *ductus arteriosus* are removed. This process is, perhaps, more remarkable in the changes of the insect than in any other known animal. They are also removing parts that are unfit for one stage of life that another structure may be substituted for them, as the cartilages, which are the substitutes for bones.

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[*] "It may be necessary to remark here, that I do not consider either the fat or the earth of bones as a part of the animal. They are not animal matter; they have no action within themselves; they have not the principle of life.

" Absorption in consequence of disease is of two kinds: the first is where wasting is produced in the whole machine, such as the wasting of the whole body, as in an atrophy; or in a part, as the wasting of the muscles of the leg, &c., from some injury done to some nerve, tendinous part, or joint. All of these I call 'Interstitial Absorption,' because it is removing parts of the body out of the interstices of that which remains, leaving the part still as a perfect whole. Interstitial absorption, however, may be carried further; it may go on till no part is left behind, as in the total absorption of the thymus gland in many animals, the *membrana pupillaris,* and often the testicle. The second kind is where the absorbents are removing whole parts of the body, beginning at one part or side, viz. that where the cause is most considerable, and going on till the whole is absorbed, which I call 'Progressive Absorption,' and in this manner ulcers are formed. This process, in some cases, produces effects which are not similar to one another; one of these is a sore, or ulcer, which is either a consequence of suppuration or produces suppuration, and therefore I have called it ulceration *. In other cases, an ulcer or sore is not produced, although whole parts are removed, of which we have many instances, as in the absorption of the alveolar processes when the teeth drop, dissolution of the callus of bones, and for this I have not been able to find a term.

- "Absorption connected with growth.
  - Absorption for nourishment.
    - Extraneous matter to become useful, as chyle, fat.
    - Interstitial absorption of parts of the body itself, as cellular membrane, muscles, &c.
  - Absorption of useless, inconvenient, or hurtful parts.
    - Extraneous, that have been useful, as synovia, and any other secretions become useless.
    - Parts of the body itself;
      - Producing wasting of a part, as a leg, an arm, &c.; or wasting of the whole body.
      - Absorption of whole parts;
        - As modellers in the time of growth.
        - In consequence of weakness, as in the removing of calluses.
        - From parts becoming wholly useless, as the alveoli.

- "Absorption in consequence of disease.
  - Interstitial absorption.
    - Partial wasting,
      - of a leg, an arm, &c.; or of the whole body, as in atrophy.
      - of a callus, of a testicle;
    - Total wasting, of calluses, alveoli, testicles.
  - Progressive absorption.
    - As when pus or any extraneous body is brought to the skin.
    - in the process of exfoliation of bones.
    - in the process of sloughing.
    - in the formation of ulcers.
      - Attended with suppuration.
    - in the removal of the fangs of the teeth... Without suppuration.
  - Mixed....... As in the progress of pus, tumours, &c., to the skin.

" The removal of a solid part of our body, or that power which the animal œconomy has of taking a part of itself into the circulation by means of the absorbent vessels, is a process that has not been in the least attended to, not being known or even suspected. I shall therefore give a slight sketch of it. I may be allowed to repeat once more, that the fat or oil of animals, and the earth of bones, have always been con-

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* " I have called this process ulceration, although not expressive of the operation or cause, but of the effect; because ulcers are formed from the operation of the absorbents.

sidered as subject to absorption: some other parts of the body being liable to wasting, have been supposed also to suffer this by absorption; but that any solid part should totally be absorbed, is a new doctrine.

"This use of the absorbents I have long been able to demonstrate; it first suggested itself to me in observing the waste of the sockets of the teeth, as also of the fangs of the shedding teeth, which was in the year 1754 and 1755, as I have published in my Natural History of those parts, in the year 1771, pages 98 and 99. When mentioning the decay of the old alveoli, as also the decay of the fangs of the temporary teeth, I made the following remark from what was premised: 'From this we see that the change is not produced by a mechanical pressure, but is a particular process in the animal œconomy.'

"This opinion was strengthened by what I observed in the process going on in the exfoliation of bones, which I showed to Dr. George Fordyce, Mr. Cruikshank, and others, above fifteen years ago; and ever since in my lectures, the first course of which was in the winter 1772; also in the year 1778, in my second Part of the Diseases of the Teeth, I there expressly mention, 'that the alveolar processes are at length "absorbed",' vide page 32; as also, in speaking of the transplanting of teeth, page 50, I observed that in some cases the socket refuses to accept of the new tooth, and when it cannot push it out, it 'sets about another mode of getting rid of it, by eating away the fang till the whole is destroyed, exactly similar to the wasting of the fangs of the temporary teeth in the young subject.' Also, in the first part of my 'Natural History,' page 98 and page 113, treating of Dentition, I there mention that the gum is removed by 'ulceration,' one of my terms for absorption of whole parts.

"It may be difficult at first to conceive, how a part of the body can be removed by itself; but it is just as difficult to conceive how a part can grow, or add to itself, which we see daily taking place. These are both certain facts, and the knowledge of the mode of action by which they are accomplished would answer, perhaps, very little purpose; but this I may assert, that whenever any solid part of our body undergoes a diminution, or is broken in upon in consequence of any disease, it is the absorbing system which does it.

"The absorption of whole living parts depends upon two circumstances, the first of which is a consciousness, as it were, in the part to be absorbed of its unfitness or impossibility of remaining under certain circumstances, whatever these are; therefore it becomes prepared for removal, and submits to it readily. These circumstances, in many cases, appear to arise from weakness, or want of power to support itself in the part to be absorbed. The second is a corresponding consciousness in the absorbent system of the necessity of removing the part to be absorbed; and without these concurring, it is impossible for any living part to be absorbed.

"When the part to be absorbed is dead matter, as nourishment, and extraneous matter of all kinds, the whole disposition is in the absorbents.

"It is by the progressive absorption that matter or pus, and extraneous bodies of all kinds, are brought to the surface of the body. It is by this process that bones exfoliate and sloughs are separated. It is the absorbents which remove whole bones, while the arteries are forming new ones. It is this operation that removes the alveolar processes when the teeth drop out of themselves, or are taken out by art; as also the fangs of the shedding teeth, which allow them to drop off; and it is by this means also that ulcers are formed.

"It becomes a substitute in many cases for mortification, and in such it seems to owe its taking place of mortification, to a degree of strength or vigour superior to that where mortification happens; and in many cases it finishes what mortification had begun, by separating the dead part. From all this, we must see that the causes of absorption of whole parts are many.

"Pressure appears to be one of the greatest causes of absorption, and it is commonly a cause of the progressive. It produces its effects not in all cases in proportion to the pressure, but according to the pressure and other circumstances combined; for we find very different effects from the same quantity of pressure: thus, under one circumstance, pressure shall give signs of strength, and produce an increase or thickening; but under another circumstance, the same quantity of pressure shall produce waste, or an absorption of the parts. This difference in effect, from the same quantity of pressure, depends upon the pressure being from without or from within; for the first effect of the irritation of pressure from without is the disposition to thicken, which I have asserted is rather an operation of strength; but if it exceeds the irritation of thickening, then the power appears to give way to it, and the absorption of the parts pressed takes place.

"Pressure produced by an extraneous body surrounded on all sides, such as pus in an abscess, acts equally on every side of the surrounding parts, and therefore every part being pressed alike, ought from this cause, singly considered, to produce absorption of those surrounding parts equally on all sides, supposing the parts themselves similar in structure, or, which is the same, equally susceptible of being absorbed; but we find that one side only of the surrounding living parts is susceptible of this irritation, therefore one side only is absorbed, and this goes on in regular progression. The side of the cavity which is susceptible of this irritation is always that which is next to the external surface of the body, therefore we have always extraneous substances of every kind determined to the skin, and to that side of the body on which the extraneous substance lies, or to which it is nearest, and that without having any effect upon, or producing the least destruction of, any of the other surrounding parts. From this cause, we find abscesses, whose seat is in or near the centre of a part, readily determined to the surface on one side in preference to any other; and whenever the lead is once taken, absorption goes on there only. But as some parts of the body are of a structure more susceptible of this irritation than others, we find that such parts are often absorbed, although they are not in the shortest road to the skin, and of such structure is the cellular membrane. We find exfoliations of bones, as well as all other extraneous bodies, approaching the skin in like manner, and from the same cause. But the progressive absorption is always more or less attended with the interstitial, and assisted by it."

"In many animals, especially the more perfect, the nourishment, or whatever is taken into the system, is taken up and carried from the stomach and other parts, by the absorbents, to an engine called the heart;

from which it is thrown out into tubes which conduct it to every part of the body, and thence it is again returned to the heart by other vessels.

"It is absolutely necessary that every one should have a tolerably clear idea of the operations and uses of these vessels, the teaching of which however, becomes more the province of the anatomist than the surgeon. But, as there is one use of the absorbing system which is not generally known, and which makes a great part of many local diseases, it is necessary that this should be well understood; and although this use has an immediate connexion with the original formation of the body, yet at present I shall only mention it slightly. However, for the better understanding all the actions of the absorbents, it will not be improper to give a short sketch of the vascular system.

"An animal body has in general been considered under the idea of an hydraulic machine, because it appears to be almost wholly composed of tubes in which fluids move. I shall not at present enter into all the different opinions concerning the uses of these tubes, especially of that system called arteries, how they are variously affected, and how they produce their various actions according to the different stimuli either of health or disease; but shall only give some general ideas of the most immediate uses of the three different systems of vessels.

"The vessels in general would appear to have more powers of perfecting themselves, when injured, than any other part of the body; for their use is almost immediate and constant, and it is they which perform the operation of restoration on the other parts, therefore they themselves must first be perfect. They would seem to have more of the Polypus in them than any other part of the body. This is, perhaps, more in the absorbents than in the arteries or veins, for we can conceive a part injured by accident, and, as it were, standing still for a little while; but we see ulceration going on very rapidly, which proves an immediate formation of vessels for absorption.

"The first two, viz. the arteries and the veins, belong immediately to the motion of the blood, or the Circulation. The arteries carry the fluid from the general reservoir, the heart, to all the different parts of the body, and the veins bring it back again.

" *Of the Arteries.*

" The arteries, which carry the fluid to all the parts of the body, constantly dispose of part of that fluid in the different operations of the body, according to their different affections; adding to the whole while growth is necessary, making up losses where the old is either improper or destroyed, and throwing out of the direct line of their motion parts of that fluid which, according to the various affections and actions of these arteries, become considerably altered in this passage, called secretions.

" The juices so secreted are intended for various purposes in the machine: some for stimulants, as the bile; some for mechanical purposes, as the tears, synovia, saliva, &c.; some for a store of nourishment, as the fat; while others are thrown out of the body as useless, because they have already performed all their purposes, as the urine, &c.

" *Of the Veins.*

" The other set of tubes—the veins—were considered as less active, being principally employed in bringing the red part of the blood back, after it had lost its most salutary parts, or performed those offices, whatever they are, for which it was sent out.

" This act of carrying back the red blood was not considered as the only office of the veins; many of their beginnings were not only supposed to arise from the terminations of arteries, but were also supposed to arise from most, if not all, the surfaces of the body, both internal and external, making so many inlets into the general system, bringing in matter into the common mass of fluids for the support of the whole; and also to bring back many of the parts which were by the arteries secreted from the blood for the different purposes of life, such as the synovia and lubricating fluids of all kinds; which fluids having answered their different purposes, and having become unfit for any further use in the machine, were obliged to be brought back again into the circulation, to be thrown out of the constitution by the arteries.

"So far the use of the veins was considered; but part of their supposed power of absorbing they were deprived of, from the discovery of that part of the absorbing system called lacteals, which were found to absorb the chyle. Though by this discovery the veins of the mesentery were deprived of the supposed use of absorbing the chyle or nourishment, yet even then they were supposed to absorb matter from the cavity of the intestines for the secretion of the bile.

"*Of the Absorbents.*

"The other part of this system, called lymphatics, though long known, was not in the least suspected of performing the operation of absorption, but they were still supposed to be continuations of the extreme ends of arteries, which were not large enough to carry red blood, only carrying the serum or lymph; but from their similarity to the lacteals, which now were known to be absorbents, it became at last plain and evident to common sense that they must also absorb.

"Before this idea was started, the general opinion of the vascular system ran thus: The arteries carried the blood for the growth, nourishment, secretion, &c., in the machine:—the veins returned the red blood, as also absorbed from every surface of the body:—the lymphatics returned the lymph of the blood, which came along the arteries; and the lacteals were sharers in the intestines by absorbing part of the chyle. But from some experiments I made to ascertain whether the veins of the mesentery absorbed or not, it was proved that they had not the power of absorption *.

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* "The next thing to the being able to write well on a subject, is the being able to be a good critic on that subject; yet, from the vast number of the latter, it would almost make us believe it was an easy matter; but vanity too often supplies the place of real knowledge, and while they are either commending or pulling down, they conceive they must appear at least more knowing than the author; besides, circumstances incline us either to be severe or in good humour. The very circumstance of being a contemporary, although dead, will sour the mind in many.

"Dr. Hunter was indisputably the first who conceived, taught, and worked up into a system, that the lymphatics commonly called, were the absorbing system; yet he could not be allowed to retain that merit.

"In the Life of Dr. Hunter, written by Dr. Simmons, we find a desire of robbing him of the discovery of the lymphatics being absorbents; and to prove that he was not the discoverer, a passage is quoted

Now, therefore, the uses of the three systems of vessels, viz., Arteries, Veins, and Absorbents, are as follow:—The arteries perform the differ-

from Noquez's works; but only a part is taken of a whole description, which part, when considered abstractedly with our present knowledge of the system, makes out a whole totally different from what was meant by the author, or what he had knowledge to apply it to; for the whole of his account of the vascular system is so irregular and incoherent, that it can hardly be understood by an uninformed reader.

"The words lymphatic and absorbent, however applied or understood by the author, whether to vessels terminating in the veins, or the thoracic duct, are quoted as proofs, although the meaning now given is entirely different from that of the author. Quotations, indeed, in general, are the most unfair proofs that can be given; for in almost every quotation there is something concealed,—a something wanting, which is supplied by the commentator.

"Noquez's work is what they call an improvement upon Keil, but I may venture to say, that those who are only able to publish the works of others, are themselves not fit to publish anything in that way, for they never can judge of what should be taken away or what should be added; for if they were perfectly master of the subject, then they certainly could make a better book upon the subject themselves.

"It is much easier for a man of real knowledge to make a new work than to mend an old one; it is clear, they can only in real knowledge be cobblers: and, indeed, there are few works that deserve a new edition, when they require additions, excepting by their original author.

"To ascertain the author's knowledge, let us follow him through the whole of his system of all the vessels, arteries, veins, lacteals, and lymphatics, for they are all connected; and that I may not be supposed to be guilty of what I am blaming in others, I have transcribed the author's own words from the French, in the original.

"'Le canal qui porte le chyle se nomme thorachique; il est composé de membranes très minces, il reçoit le chyle des veines lactées et la lymphe des vaisseaux lymphatiques, et il porte ces liqueurs dans la veine souclavière.'—*Anatomie* de Noquez, p. 152.

"'On pourroit distinguer quatre sortes de vaisseaux lymphatiques: les premiers naissent des extrémités artérielles, comme dans l'œil à la peau; on les nomme artères lymphatiques, qui peutêtre ne sont autre chose que les conduits excrétoires d'une lymphe très subtile, ou de la matière qui transpire. Les second vaisseaux lymphatiques sont veineux; ils reportent la lymphe dans les vaisseaux sanguines ou dans les veines; il y en a dans toutes les parties du corps; ils repompent la matière lymphatique qui s'evacue par les premiers: on peut les nommer conduits absorbans. Ceux de la troisième espèce sont les lymphatiques, qui vont au reservoir du chyle, au canal thorachique, à la veine cave, à la veine porte, &c. Ceux de la quatrième espèce naissent des artères sanguines, et après avoir fait quelque temps l'office d'artères, ils se changent en veines et vont aboutir aux veines sanguines."—*Ibid.* p. 155.

"'Les artères lymphatiques sont des petits conduits coniques qui naissent des artères sanguines, mais qui n'admettent que la partie sereuse ou la partie la plus subtile du sang: on les nomme mal à propos artères, car elles ne sont plus continues avec les veines lymphatiques. Elles ne sont autre chose que des conduits excrétoires, dont le nombre est presque infini; elles sont répandues sur la peau et sur toutes les membranes, de là viennent l'humidité des membranes et les vapeurs qui s'exhalent des parties à la peau; on les nomme conduits de la transpiration. Les veines lymphatiques ne sortent point des artères;

ent and immediate actions of the machine as before:—the veins replace the blood for the repetition or continuance of these actions as before, but

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ce sont de petits conduits, qui s'ouvrent sur toutes les membranes et sur la peau; et comme ces conduits ne communiquent point avec les artères, et qu'ils vont toujours en grossisant, ils reçoivent les liqueurs qui s'exhalent par les conduits excrétoires ou les artères lymphatiques, et les conduisent dans les endroits où ils vont aboutir: on nomme conduits absorbans les veines lymphatiques avant qu'elles soient assez grosses pour être sensibles à la vûe. On a prix pour des vaisseaux lymphatiques les extrémités des artères et des veines qui communiquent ensemble, parce que dans ces endroits on remarque une liqueur transparente: mais on se trompe; cette liqueur n'est point de la lymphe proprement dite; ce n'est que du sang, qui, comme on l'a déja observé, change de couleur, et devient transparent dans les extrémités capillaires à force de se diviser: en effet, à mesure que les veines qui viennent de ces extrémités croissent, le sang reprend sa couleur rouge, ce qui n'arrive point dans les veines lymphatiques ou le lymphe conserve toujours sa couleur, quoique les vaisseaux sont gros.'—*Anatomie* de Noquez, p. 395.

" For the better understanding of this subject, it may be necessary to mention, that the author divides the arteries into two classes, which may be called the first and second classes of arteries; and he also divides the veins into two classes in the same way.

" The first class of arteries consists of those that carry the whole blood when in a mass, and are called sanguinary. The second, of those which strain off the lymph, and are called lymphatic: these last terminate either on surfaces, or in the second class of veins called lymphatic veins.

" The veins of the first class are those which bring back the whole blood, and are called sanguinary. Those of the second class either take their rise from the above-mentioned surfaces, on which the lymph was deposited by the second class of arteries, and correspond with the first class of lymphatic arteries,—and which, with him, are the absorbents,—or they take their rise from the second termination of lymphatic arteries, and open into the sanguinary veins. These are called lymphatic veins.

" This is exactly the doctrine of the day; and nowhere in his works does he, either directly or indirectly, contradict it.

" In page 152, he takes notice of the thoracic duct, and says, 'The canal through which the chyle passes is called thoracic; it is composed of very thin membranes; it receives the chyle from the lacteal vessels and the lymph from the lymphatic vessels,'—which lymphatic vessels are, according to him, those of the third kind,—' and carries them to the subclavian vein.'

" In page 155, he describes the whole system of lymphatic vessels, and says, 'We may distinguish four kinds of lymphatic vessels: the first arise from the arterial extremities, as in the eye and on the skin; they are called lymphatic arteries, which are, perhaps, nothing more than the excretory ducts, through which a very subtle lymph passes, or the matter of transpiration.' This first kind is plainly continuations of arteries, either not capable or not disposed to carry red blood, and which throw out their contents upon surfaces as exhalents, as also probably secreting arteries, and have always been, and are at this day allowed. 'The second kind of lymphatic vessels are veinous; they bring back the lymph into the blood-vessels, or into the veins; they are placed in all parts of the body; they suck up the lymph which has been thrown out by the first kind or lymphatic arteries; they may be called absorbent vessels.'

" These are the vessels that are mentioned as a proof of Noquez, knowing the absorbent system; but we shall find from the termination he gives them, that he did not mean, or in the least know, the abhave now lost their power of absorbing:—the absorbents exclusively perform those actions, a summary of which we have previously given."

Hunterian MS. Catalogue.

sorbent system as we now understand it, which Dr. Simmons ought to have seen. These second are plainly what had always been supposed to have been absorbents before Dr. Hunter's discovery of what he calls the third kind were absorbents; for he mentions just before that they 'are veinous, bringing back the lymph into the blood-vessels or into the veins;' that is to say, the lymph which is thrown out by the first class of lymphatic arteries.

"Now if he had conducted those to the receptaculum chyli instead of the red veins, it would have been plain that he understood the absorbing system as it is now known; but it is the following which he conducts to the thoracic duct. 'Those of the third species are those which go to the thoracic duct, to the vena cava, to the vena portarum, &c.' These third are what we now call the absorbent system, only we do not allow of any going to the vena portarum; but he does not say from whence they arise, although they were supposed to be continuations of lymphatic arteries, which is a very singular omission, and shows either great ignorance of their supposed origin, or a strange neglect. I have only been astonished at this not being brought as a proof of his knowledge.

"'Those of the fourth kind arise from the sanguinary arteries, and after performing the office of arteries, they change into veins, and are inserted into the sanguinary veins.' This fourth is a part of the circulation, a process always allowed; they are the direct continuation of those arteries that only carry lymph, but do not terminate on surfaces, or are exhalers, as in the first, and therefore may be called the second order of lymphatic arteries.

"In page 395, he further states, that 'The lymphatic arteries are small conical vessels which arise from the blood arteries, but which admit the serous or more subtle part of the blood only: they are improperly called arteries, because they are not continuous with the lymphatic veins properly so called. They are nothing more than the excretory vessels, whose number is almost infinite: they are dispersed upon the skin, and upon all the membranes, from whence arise their moisture, and those vapours which exhale from them. Those in the skin are named transpiration ducts.'

"This is almost a repetition of what was said of his first kind of lymphatics, page 155.

"'The lymphatic veins' (viz. his second kind of veins,) 'do not arise from the arteries; they are small canals, which open upon all the membranes, and upon the skin; and as these canals do not communicate with the arteries, and as they go on enlarging, they receive those fluids which exhale from the excretory ducts or lymphatic arteries, and carry them to those parts in which they are inserted.' (Which insertion he gives us in p. 155.) 'The lymphatic veins are called absorbent canals before they are large enough to be visible to the naked eye.'

"Thus, by taking his supposed origin of one system of vessels, and applying it to another, whose origin he does not even mention, and giving them a termination which we allow, he is supposed to have known the absorbing system as we now know it." *Hunterian MS. Catalogue.*

SERIES I. Nutritious Absorbents

"Are the vessels, whatever they may be, which convey the nutritious part of the food to the system of vessels which supports the machine.

"In plants, the fibrous roots answer this purpose, as indeed all other sorts of roots, conveying the nutritious part from the earth to the vessels of the plant.

"In animals, these vessels must originate from the stomach and go to the blood-vessels.

"In some there is only a simple canal from the stomach to the heart, as in the cuttle-fish *; in others, these vessels are very numerous."

Hunterian MS. Catalogue.

Sub-series 1. In Plants.

842. A Hyacinth (*Hyacinthus orientalis*, LINN.), showing the numerous radicles descending from the bulb, which absorb from surrounding matter the particles adapted for the support and increase of the plant.

2. *In Animals.*

a. *Forming part of the Circulating System.*

843. A portion of a Tape-worm (*Tænia Solium*, LINN.), in which the nutrient vessels have been injected with mercury. These commence at the mouth and run longitudinally down the body, one on either side, near the margins of the segments, at the posterior edges of which they are connected by transverse canals.

844. Six portions of the same species of Tape-worm, with the longitudinal and transverse nutrient vessels, filled with coloured injection. In the middle portion, placed towards the front of the bottle, the ramified ovaries are filled with a white injection, by which their form is beautifully displayed.

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* Mr. Hunter seems here to have considered the subdivided glandular bodies which surround the biliary ducts as appertaining to the absorbent system; but in a previous part of the MS. Catalogue he calls these parts *Pancreas*. (See Preparation No. 775.)

The ovarian vessels are injected also in a few joints of the portions on the opposite side.

"The preceding preparations, though forming part of the original Hunterian Collection, were made by Sir Anthony Carlisle, F.R.S. F.L.S., and are described by him in his 'Observations upon the Structure and Œconomy of Tæniæ,' published in the Second Volume of the Linnæan Transactions (1794), from which the following observations are extracted.

"The internal structure of the joints composing the body of this animal is partly vascular and partly cellular; the substance itself is white, and somewhat resembles in its texture the coagulable lymph of the human blood. The alimentary canal passes along each side of the animal, sending a cross canal over the bottom of each joint, which connects the two lateral canals together.

"I have often injected three feet in length of these canals with coloured size, by a single push with a small syringe. The injection will not, however, pass from below upwards along these canals; I could never make it go in this direction beyond two joints, and it appeared to be stopped by valves in the lateral canals, situated immediately below the places where the cross canals are sent off. The alimentary canal, as it is here described, is continued into the extreme joint, where it becomes impervious, there being no opening analogous to an anus." *Carlisle, ut supra*, p. 251.

845. A portion of *Tænia Solium* and a Liver-fluke (*Distoma hepaticum*, Rud.), with the nutrient vessels injected with coloured material. In the *Tænia*, the arborescent ovary of one of the joints is filled with green injection, and the duct leading from it to the marginal outlet is well displayed.

Prepared by Sir Anth. Carlisle.

846. Two specimens of Liver-fluke, in which the nutrient, and also the generative vessels have been injected.

846 A. A portion of a Tape-worm taken from the intestines of a Python (*Bothriocephalus Pythonis*), in which the nutrient vessels are partially injected with mercury, showing the longitudinal vessels connected by transverse canals at the posterior margins of the segments, as in the true *Tæniæ*.

Prepared by Mr. Owen.

These parenchymatous entozoa, deriving their support from already animalized fluids, do not require the complicated digestive apparatus the modifications of which are displayed in the preceding subdivision; their food is therefore transmitted along canals of small and nearly uniform diameter, excavated in the parenchyma of the body, analogous to the sap-vessels of plants, and combining the functions of digestive, absorbent, and circulating organs.

847. A Medusa (*Rhizostoma cœrulea*, Cuv.). An injection of size and vermilion has been thrown into the central cavity, or stomach, and has filled the canals which lead to that cavity from without, and has passed also into a few of the canals which distribute the animalized fluid to the rest of the body. The latter vessels anastomose freely, and form a beautiful network around the margin of the disk, where they are visible by means of their coagulated contents, although the injection has not reached them. In this simple organism we find, therefore, the food absorbed, as in plants, by the extremities of finely ramified processes; but the fluid so absorbed, instead of being conveyed to the system by a continuation of the same vessels, is poured into a central digestive cavity, which is the great characteristic of the animal structure. From this reservoir, it is taken up by another system of vessels, combining, like the sap-vessels of plants, the functions of the lacteals and of the arteries of the higher animals. These vessels, also, by their minute ramifications within the thin margin of the disk, submit the nutrient fluid, as in the leaves of the plant, to the influence of the surrounding medium; and here, probably, it is rendered fit for the purposes of ultimate nutrition.

848. A portion of one of the roots or branched processes of a *Rhizostoma*. The canals which are continued from this part to the stomach have been injected, and may be traced to the margins of the processes, where they commence by minute orifices, which absorb from the surrounding medium the material adapted for the support of the animal. These are not distinct tubes, but are canals excavated, as in the *Tæniæ*, in the substance of the animal's body.

849. A Sea-mouse (*Aphrodita aculeata*, Linn.), with the parietes of the left side of the body removed, in order to show the intestinal cæcums of that side,

and the minute plexiform absorbent vessels which are continued from them, and which convey the nutriment to the general system, without the intervention of a heart. In this preparation (which is suspended with the head downwards, in order to preserve the natural position of the intestinal cæcums,) the alimentary canal and general disposition of the tegumentary parts are clearly exposed.

The alimentary canal has been injected with milk, which has passed freely into the hepatic cæcums, and even into some of the minute absorbent vessels.

The dorsal parietes of the body are seen to be composed of an external felted tunic, a middle thin covering, disposed in transverse squamæ, and an internal thinner membrane, which forms, like the peritoneum, the immediate lining of the abdominal cavity, and is disposed in a series of transverse lateral compartments, in each of which an intestinal cæcal appendage and its absorbent vessels are lodged. The three tunics above mentioned do not cohere, but leave free intervening spaces, to which the sea-water has access. The second and third tunics only are continued to form the ventral parietes; but between these are situated two longitudinal bands of muscular fibres, one of which is shown adhering to the internal membrane.

b. *Superadded to the Circulating System, and termed Absorbents of the Digestive System, or Lacteals.*

850. A portion of the intestine of a Turtle (*Chelonia Mydas*, Brogn.), with the peritoneal and muscular coats reflected from the internal membrane, so as to show upon the latter the plexiform absorbent canals, from which the lacteals take their origin, injected with size and vermilion.

851. A portion of intestine inverted, of the same species, with the absorbent plexus similarly injected, and seen through the thin internal coat.

852. A similar preparation, in which the longitudinal course of the absorbent canals, and their intercommunications, are well shown.

853. A similar preparation, dried and preserved in oil of turpentine.

854. A larger portion of the intestine of a Turtle, with the plexiform absorbent

canals, partially filled with mercury, dried and preserved in oil of turpentine.

855. A portion of the intestine of a Hawk's-bill Turtle (*Chelonia imbricata*, Brogn.), with the absorbent plexus more completely filled, and with some of the lacteals which are continued from them injected on the opposite side beneath the peritoneum.

856. A portion of the intestine and mesentery of the same species, showing numerous lacteals passing along the mesentery. These vessels unite freely together, and form arches; they are of large size and have but few valves.

856 a. A small portion of the intestine of a Turtle, with the arteries injected with size and vermilion, and the absorbent plexus and lacteals well filled with mercury. This preparation shows the course of the lacteals upon the intestine, where, after passing from the plexiform canals and through the muscular coat, they generally affect a longitudinal direction, except where they accompany the blood-vessels to get upon the mesentery.
Mus. Brookes.

857. A small portion of the intestine and mesentery of a Turtle, with the arteries, veins, and absorbents injected, the first with red, the second with green injection, and the third with mercury; dried and preserved in oil of turpentine.

858. A portion of the intestine and mesentery of a Turtle, with the veins filled with blue injection, and the absorbents with mercury.

858 a. A similar preparation, with the lacteal absorbents successfully injected.
Prepared by Sir Wm. Blizard, F.R.S.

859. A small portion of the intestine of a Horse, with the lacteal absorbents injected with mercury; preserved dry.

860. A portion of the intestine and mesentery of a Porpesse (*Phocæna communis*, Cuv.), with the arteries and mesenteric branches of the lacteals injected. Some of the intestinal lacteals may be seen distended with coagulated chyle.

861. A portion of the mesentery of a Hog (*Sus domesticus*, Linn.), showing the small mesenteric arteries filled with red injection: these do not anasto-

mose and form arches as in most mammalia. The veins are injected with yellow. A part of the mesenteric gland is shown, which is continued along the root of the mesentery, and through which the lacteals pass before terminating in the receptaculum chyli.

861 A. The posterior walls of the thorax of a Cat (*Felis Catus*, LINN.), with the thoracic aorta, superior cava, trachea, and thoracic duct. The latter vessel is filled with mercury: it is seen ascending behind and to the right of the aorta, it then inclines to the left, and terminates at the commencement of the vena innominata. The contents of the lacteals and of the greater part of the lymphatics are carried by this great trunk of the absorbent system into the general circulation. *Mus. Delafons.*

SERIES II. Excretory Absorbents.

1. *Lymphatic Vessels.*

862. A portion of a plexus of absorbent vessels from the head of a Spermaceti Whale (*Physeter macrocephalus*, LINN.), filled with spermaceti, which was by their action in progress of removal. This valuable preparation affords a strong argument in favour of the doctrine that the waste and superfluous parts are removed by the absorbents, and not by the veins.

863. A portion of an absorbent vessel of a Dromedary (*Camelus Dromedarius*). It has been dried, after having been distended with mercury, and shows well the numerous valves which characterize this class of vessels.

864. A portion of the lung of a Turtle, with the absorbents injected with mercury, which shows their reticulate disposition.

864 A. A portion of the superficies of a human lung, with the absorbents similarly injected, and having a similar reticulate disposition.

Presented by Sir Wm. Blizard, F.R.S.

865. A portion of the heart of an Ass (*Equus Asinus*, LINN.), with the arborescent ramifications of an absorbent vessel injected with mercury.

866. A portion of the heart of an Ass, including one of the coronary arteries and veins, and the absorbent trunk which accompanies them.

867. A portion of the human liver, with the absorbents injected with mercury. The disposition of these vessels on this viscus is arborescent, but the branches are much more numerous and closely set than upon the heart.

867 A. The human gall-bladder with its absorbents injected, which are very numerous, and are more irregularly reticulate than upon the lungs. It is by means of these vessels that the bile is altered while in this receptacle, its serous parts being taken up, and the qualities which depend upon its other components being proportionately heightened. The absorbents on that side of the gall-bladder which is next the liver are very numerous.
Mus. Brookes.

868. The gall-bladder of an Ox (*Bos Taurus*, LINN.), with part of the absorbents on the anterior surface injected, showing their communication with the trunks which accompany the biliary ducts and vessels.

868 A. A portion of the liver of an Ox, with the absorbents beautifully injected with mercury. The yellow tinge of the oil of turpentine in which the preparation is preserved, gives the absorbents the appearance of being filled with fine gold. *Prepared by Sir Wm. Blizard, F.R.S.*

868 B. A portion of the spleen of a Calf, with the absorbents injected with mercury. They are seen in some parts to be remarkably abundant, the branches running close, and almost parallel to each other, but with frequent anastomoses. *Prepared by Sir Wm. Blizard, F.R.S.*

868 C. A portion of the fascia and subjacent parts of the human leg, taken from near the knee-joint, with the absorbents injected with mercury. On the side of the bottle opposite the number, a part of the spleen and spermatic chord, with the absorbents similarly injected, is displayed.
Prepared by Sir Wm. Blizard, F.R.S.

2. *Lymphatic Glands.*

869. Two inguinal glands from the human subject, with the absorbent vessels connected with them, injected with mercury. The small absorbents en-

tering the lower gland, or *vasa inferentia*, are in this instance fewer in number than the *vasa efferentia*, or larger vessels, emerging from the gland[*].

870. An inguinal absorbent gland and vessels, injected with mercury. The *vasa inferentia* are here seen to be more numerous than the *vasa efferentia*, which is the disposition most commonly observed in lymphatic glands.

871. Portions of the two carotid arteries from the neck of a Fowl (*Phasianus Gallus*, LINN.), with a number of absorbent glands, analogous to the *glandulæ concatenatæ cervicales*, accompanying the vessels.

872. A portion of the œsophagus of a Crane (*Ciconia alba*, CUV.), and the arteriæ innominatæ, showing two lobulated glands, which are termed 'lymphatic glands' in the MS. Catalogue. They are situated upon the origins of the carotid arteries, and have been considered by some anatomists as analogous to the thyroid glands of mammalia, and by others as analogous to the thymus.

SUBDIVISION IV.

CIRCULATING SYSTEM.

SERIES I. Circulation in Vessels without a Heart.

SUBSERIES 1. *Without Sinuses, or Dilatations, between the Arteries and Veins.*

873. A Leech (*Hirudo medicinalis*, LINN.), with part of the abdominal parietes and the stomachs and intestine dissected away, to show the two lateral wavy vessels, the greater part of that on the right side being injected with size and vermilion. This injection has penetrated a few of the minute vessels which pass towards the mesial plane on the ventral aspect of the body, to communicate with similar branches from the opposite vessel; it has also passed into some of the larger branches given off from the op-

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[*] Mascagni has figured a similar disposition of absorbent vessels in an inguinal gland.—*Vasorum Lymphat. Hist.* Pl. I. fig. 10.

posite side of the trunk, and which pass round the outside of each digestive sac.

The nervous chord may be observed running along the centre of this preparation, accompanied towards the lower part by a smaller and less distinct linear substance, which is probably the remains of the ventral vessel. The organs of generation, the respiratory sacs, and the folded glandular canals connected with, and lying upon, the lateral vessels, are also shown: bristles are placed behind some of the folded glands.

874. A Leech, with the alimentary canal distended with coagulum, and with the integument removed from the left side to show the wavy vessel or vein of that side. It is uninjected, but may be distinctly traced from one end of the body to the other. The dorsal branches of this trunk are also visible: those towards the head run in the interspaces of the lateral digestive sacs, but towards the opposite end of the body the branches pass over the sacs to the dorsal aspect of the body. Near the head some of the respiratory sacs are preserved; the nervous chord, and the left canal continued from the testes, are also shown in this preparation.

875. An Amphinome (*Amphinome capillata*, Brug.), laid open along the ventral aspect, the sides of the body divaricated, and the intestinal canal turned aside to show the principal trunks of the vascular system.

Slips of blue paper are placed behind the great intestinal vein. This is continued at the lower end of the intestine into the ventral or inferior lateral vessels, which, in conjunction with the veins from the different segments, form the internal branchial plexuses, and give off the vessels of the external gills. From these respiratory organs the blood is collected into the dorsal or superior lateral vessels, from which the aerated blood is carried by a few irregularly disposed branches to the dorsal artery. This vessel extends the whole length of the body, diminishing at both extremities. At its middle part it gives off the large mesenteric vessel, which forms one large arch, from the convexity of which several smaller branches are given off, which unite upon the intestine to form an artery on the dorsal aspect, which runs parallel to the vein on the opposite side, from which our description of this circulation commenced.

The portion which was removed from the left side of this preparation is placed among the respiratory organs. The external gills are the penniform processes, which are situated on either side of the mesial row of dark spots on the dorsal aspect of the body. The packets of hairs external to the gills are locomotive organs, and are arranged in a double series —dorsal and ventral—on either side of the body. The tongue or proboscis is protruded, and a bristle is placed in the mouth.

875 A. A Sea-mouse (*Aphrodite aculeata*, LINN.). This has been laid open on the dorsal aspect, the sides of the body divaricated, and the muscular stomach removed, to show the principal trunks of the vascular system. These vessels are not so conspicuous, and apparently not so numerous as in the Amphinome, but the dorsal artery, and the ventral vein, and a few of its branches may be distinctly seen against the dark paper. The intestine has been injected with size and vermilion, which have penetrated some of the lateral cæcums. *Prepared by Mr. Owen.*

2. *With Sinuses, or Dilatations between the Arteries and Veins.*

876. The anterior part of an Earth-worm (*Lumbricus terrestris*, LINN.), with the dorsal parietes of the body removed to show the dorsal vessel, or artery, and the dilated receptacles, which at this part of the body form the communications between this vessel and the principal one on the ventral aspect. These receptacles or sinuses are ten in number [*], arranged five on either side; they pass obliquely backwards from the ventral to the dorsal vessel, and curve outwards, so as to leave a central passage for the œsophagus: bristles are placed between the œsophagus and the sinuses.

877. The head and anterior part of the alimentary canal of an Earth-worm, with the corresponding parts of the great dorsal and ventral vessels, and the ten intercommunicating sinuses. The conjunction of these cavities with the ventral vessel is here more especially shown; this vessel is empty, but the sinuses and dorsal vessel contain irregular portions of coagulated blood.

In this and the preceding preparation a bristle is inserted at the mouth, above which may be seen the proboscis. The glandular mass surrounding the pharynx, the crop distended with earth, the circular gizzard and commencement of the intestine, are also clearly displayed.

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[*] They have occasionally been observed to exceed this number by two or four.

878. The anterior moiety of an Earth-worm laid open along the back, and the parietes of the body divaricated, to show the dorsal vessel, the sinuses, and more particularly the oblique muscles which surround the latter, and aid in expelling their contents *. Besides the parts shown in the preceding preparations, there are here preserved the ovaries and testicles; and the yellow, elongated, biliary organ on the dorsal aspect of the intestine is rendered visible by the dark colour of the intestinal contents.

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* The opinions of comparative anatomists respecting the nature of the dorsal and ventral vessels of the Earth-worm, and the motion of the blood in them, are various and contradictory. Mr. Hunter has left no observations on this point: the description of No. 876. in the original MS. Catalogue is, "The head and upper part of an Earth-worm, on one side dissected to show the hearts, viz. ten;" and of 877, "Ditto, dissected on both sides."

Sir Everard Home (*Phil. Trans.* 1817, p. 3,) considers the dorsal vessel as the artery, and states that the blood is forced by its action up to the head. Marcel de Serres (*Mém. du Mus.* 1818, p. 162.) is of the same opinion. Morren, in his elaborate treatise *De Lumbrici terrestris Historiâ Naturali*, (4to, 1829,) also considers the dorsal vessel as the artery, but states that the blood is propelled along it towards the tail, "attamen satis est visibilis ut perspiciatur sanguinem, denuo ascensum per vasculum ventrale, descendere per aortam."—p. 167; comp. also p. 164. Dugès, (*Annales des Sciences Naturelles*, xv. p. 304,) on the contrary, regards the ventral vessel as the aorta, and the dorsal vessel as the vein.

From my own observations, frequently repeated, on young Earth-worms, when the parts are sufficiently transparent to allow the blood-vessels to be seen through the integument, the blood is plainly seen to pass along the dorsal vessel from the tail towards the head: successive quantities follow each other, occupying from a tenth to a sixth part of the whole length of the vessel. After having passed over the union of the lateral dilatations, the blood is jerked by an accelerated motion to the head, and passes by lateral branches on either side the œsophagus to the ventral vessel. This vessel is smaller than the dorsal vessel, and the blood passes down it in a more continuous stream. The motion of the blood in both vessels seems to be greatly assisted by the peristaltic actions of the alimentary canal.

The muscular capsules of the sinuses, derived from the common muscular system, prevent their over-distension, assist in expelling their contents, and give them the character of true hearts, with which, however, they are not intrinsically identical. The superaddition of the sinuses to the vascular system of this Annelide has an evident relation to its habits, a due and rapid supply of blood being thus insured to the muscles of the anterior part of the body during the vigorous actions required in boring and penetrating the soil.—R. O.

SERIES II. Structure of the Heart.

"The Heart is an organ or machine not common to all animals. many being entirely without any such organ; how far it accompanies the brain I have not yet discovered, but I suspect that a distinct brain and a distinct heart go together. Where there are both brain and heart, they keep an exact analogy *; so much so as to teach from the one what the other is like, which would make us suspect that they are always to be found in the same animal.

"The situation of this viscus is generally near the upper, or what may be called the anterior part of the body of the animal; but this is not universally so, only in those animals where nature would keep pretty near to general rules, such as in the general structure of the more perfect animals, down to fish †; but beyond them it is not clear where the heart may be placed in an unknown animal, and it is even differently situated in the same genus, for instance, the situation of the heart in the Shell Snail is not the same with that of the Black Snail, or Slug ‡.

"The external form of the heart varies in different animals, and that

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* Without an accurate definition of what Mr. Hunter here intends by a brain and a heart, it would be difficult either to refute or confirm his assertion. It appears, however, to be contradicted by the following facts: the supracœsophageal ganglion is proportionately larger in some insects than in the crustaceans, which have a much better defined and more powerful central organ of the circulating system; and if we compare the insects with the acephalous bivalves, as the *Oyster* or *Arca*, the disproportion in the development of brain and heart is still greater, since these mollusks, which have the supracœsophageal ganglion much less developed than in either insects or crustaceans, have a more complex heart than fish, though in a different relation to the respiratory organ: the dibranchiate cephalopods, again, which have distinct and well organized hearts for both the less and greater circulations, are, as regards the brain, much inferior to fish; lastly, in the vertebrate classes, the birds present the most perfectly organized heart, but the mammalia the highest-developed brain.

† Viz. the *Αναιμα* of Aristotle, or the *Vertebrata* of Lamarck.

‡ The term *genus* is here used in a more extended sense than is consistent with the methods of modern zoology. The examples given by Mr. Hunter are, however, closely allied in their general structure. In the Snail, or *Helix*, the heart is situated on the right side of the posterior third of the pulmonary sac; in the Slug, or *Limax*, it is situated at nearly the middle of the posterior surface of the pulmonary sac, and protected above by the rudimentary shell. See Nos. 882 and 883.

difference most commonly corresponds with the shape of the part in which it lies; as in the human it is flattened on the anterior surface, answering to the flat breast; more so in the seal, otter, &c.; but this does not always take place in flat chests.

"In general it is a cone, more or less flattened on one or two sides, but principally on one. This flatness generally constitutes the great difference in the shape of the heart of any one class, whilst its shape in each class differs according to its different purposes in each, or the number of parts of which it is composed.

"The heart is a muscle or muscles making the parietes of cavities which have no fixed point of action excepting an imaginary one, viz. the centre of the cavity, to which the whole body of the muscle moves in its action, by which means the cavities are lessened.

"The heart is in general divisible into a number of cavities, the greatest number consisting of four, the fewest consisting of one only.

"The first (or most complex) division occasions a distinct and double motion of the blood; the second, a mixed motion; the third, a single circulation, but attended with a very singular circumstance in its passage, viz. in gills; and the fourth, not a circulation but an undulation."

Hunterian MS. Catalogue.

SUBSERIES 1.—*Situation of the Heart.*

"The situation of the heart in the body varies in different animals. One would imagine when the animal was divided into its several portions appropriated for the different purposes, that the situation of the heart would be nearly the same in all; but we find this not to be the case; its situation depends upon the organs of respiration more than any other part. It is placed in what is called the chest in the quadruped, bird, amphibia, in fish, and in the aquatic and terrestrial insect; but not in what may be called the chest in the flying insect. The chest in the abovenamed animals seems best suited to contain the lungs and branchiæ, and therefore the heart is placed there; but as the lungs of the flying insect are placed through the whole body, the heart is more diffused, extending through the whole length of the animal. The situation, therefore, of the heart is chiefly connected with that of the lungs; and when it is united with the body at large, it is because the lungs are also so disposed. We must suppose that these two have a relation to each other."

Hunter, On the Blood, p. 137.

879. A Silk-worm, or Larva of the *Bombyx Mori*, Fabr., with the dorsal parietes of the body removed to show the situation of the dorsal valvular vessel, or heart. It extends along the middle line of the body from one extremity to the other, and gradually diminishes in diameter as it advances towards the head.

880. The body of a Lobster (*Astacus marinus*, Fabr.), with the dorsal parietes removed to show the heart. It is a single cavity, unprovided with auricles, and situated, as in insects, in the middle line of the back; but it is a more circumscribed, compact, and muscular body, and does not extend in the longitudinal direction beyond the space which intervenes to the extremities of the branchiæ.

881. The soft parts of an Oyster (*Ostrea edulis*, Linn.), with part of the mantle-lobes dissected away. The heart is situated near the dorsal aspect of the body, between the liver and the adductor muscle, in a peculiar cavity, or pericardium, which is laid open on the left side, showing it to be composed of a ventricle and a double auricle. A black bristle is placed in the mouth, and a brown one passed through the liver, around which winds the alimentary canal.

882. A Snail (*Helix Pomatia*, Linn.), with the shell removed in order to show the heart, which is situated on the left side of the dorsal aspect of the body, near the posterior part of the branchial sac. The pericardium is laid open, and the heart being injected, the auricle, from its thinner parietes, is seen of a red colour: a bristle is placed behind the ventricle, and the aorta may be observed ramifying over the liver.

883. A Slug (*Limax ater*, Linn.), with the rudimentary shell which protects the heart, and part of the dorsal integuments removed to show the heart, situated in the middle line of the back.

884. A freshwater Muscle (*Anodon Cygneus*, Sowerby), with part of the valves

removed in order to show the heart. It is situated in the middle of the dorsal aspect opposite the hinge: the pericardium being laid open, it is seen to be composed of an elongated ventricle, and two lateral auricles. The intestine in this species passes through the cavity of the ventricle in the direction of its long axis. See No. 900.

885. A Cuttle-fish (*Sepiotheuthis loliginiformis*, De Blainv.), with the ventral parietes of the body removed to show the hearts, which are three in number, and separate from each other. They are, however, situated in one cavity, or pericardium, immediately below the branchial cavity, and towards the ventral aspect of the body. The pericardium having been laid open, the two divisions of the vena cava are seen diverging to each branchial heart, behind which and its appendage a slip of blue paper has been placed. The larger and more muscular systemic heart is situated in the middle line between the branchial hearts: a slip of red paper is placed behind it. It is of a transversely oblong figure, with the right extremity bent upwards, and gives off an artery from its anterior and posterior extremities.

886. A small Diodon (*Diodon 9-maculatus*, Cuv.). The mouth has been laid open by dividing the lower jaw, the expanded cavity of the œsophagus exposed, and the heart displayed by the removal of part of the pericardium. It is composed of a single auricle and ventricle, and is situated immediately below the pharynx, and in the close vicinity of the branchial arches. In this preparation the laminated gills of the left side are seen: one bristle is inserted into the lower œsophagus, which is continued from the dilated cavity, and another into the rectum.

887. A Frog (*Rana temporaria*, Linn.), with the ventral parietes of the body and all the viscera removed but the heart, in order to show its situation in the middle line, and with its long axis nearly parallel to the long axis of the body.

888. A young Turtle (*Chelonia Mydas*, Brogn.), injected, and with the ventral parietes of the body removed to show the heart, which is composed of two distinct auricles and one ventricle, and is situated, as in the frog, in the middle line of the body. The pericardium has been in great part re-

moved, its serous layer is continued upon the fibrous layer from the apex of the heart, as well as from the great vessels at the base.

889. The thorax of a Duck (*Anas Boschas*, LINN.), with the anterior parietes removed to expose the heart, which is situated in the mesial line, and with its long axis parallel with the long axis of the body.

890. A human fœtus, with the anterior parietes of the chest and abdomen removed, showing the heart and other thoracic viscera, separated from the abdominal organs by a complete septum or diaphragm. The greater part of the heart is situated to the left of the mesial plane, and its apex is directed to the same side. This deviation from the position usually observable in the mammalia, appears to relate to the greater development of the right lobe of the liver, which encroaches upon the cavity of the chest, and diminishes its longitudinal diameter on that side; and also to the shortness of the vena cava inferior, which, terminating in the right auricle as soon as it has passed through the diaphragm, closely connects the base of the heart to the diaphragm; and, as the flatness of the human chest prevents the apex protruding forwards, the heart is necessarily turned to that side which is least encroached upon by the abdominal viscera.

2. *Heart consisting of one Cavity, which is a Systemic Ventricle, or distributes the Blood to the general System.*

a. *Without a Pericardium.*

891. A Silk-worm (Larva of *Bombyx Mori*, FABR.), injected, with the integument of the back removed to show the dorsal vessel, or heart. The following is Mr. Hunter's description of this organ.

"The heart of the caterpillar runs all along the back its whole length. It begins to contract at the tail of the animal, and the contraction runs from thence to the head. It can be traced all along by the eye. The circulation of the insect is very slow, if we may judge of the whole class by the motion of the heart in the caterpillar. In the silk-worm, for instance, the heart beats only 34 in a minute. However, I have known in the adult human, the pulse as low when in visible health; and this for many years. The blood in the winged insect must be small in quantity, for when we open any one, we hardly observe any moisture.

"But as an insect has two active states, viz. the maggot, and complete or fly, we find the blood very different as to quantity in these two states. In the maggot, or caterpillar, it is large in quantity; in the fly state it is hardly perceivable. This last takes off weight in flying."

Hunterian MS. Observations on Insects.

892. A Silk-worm similarly prepared, to show the heart.

893. A Silk-worm, with the dorsal integument reflected towards one side, showing the lower or dilated part of the heart adhering thereto, and injected with size and vermilion.

894. A Silk-worm, with the dorsal integument dissected off, and the body distended with a similar injection, which has also filled a great part of the heart.

895. A large Silk-worm, partially injected and dissected, to show the heart, a portion only of which, however, can be seen at the lower end of the preparation.

896. A Silk-worm injected, with the dorsal parietes of the body and part of the viscera removed, to show the extended cavities, which serve as veins, and in which the filamentary glandular tubes float and imbibe the materials for their respective secretions. A bristle is placed behind a portion of the silk glands.

897. Larva of the Puss Moth (*Cerula Vinula*, Leach,) injected, and with the dorsal integument removed, to show the heart and the artery continued from its anterior extremity. The injection, which has been thrown into the extended venous cavities, has penetrated the heart. The lateral ligaments or muscles of the heart, which converge to be inserted into the dorsal integument, are preserved in this preparation.

898. A Humble-bee (*Bombus terrestris*, Latr.), with the ventral parietes and viscera of the abdomen removed to show the heart, which extends along the dorsal aspect of that cavity, and diminishes as it approaches the head. It may be seen to be divided into compartments corresponding to

the abdominal segments, the anterior end of each division of the heart appearing to be inserted into the posterior end of the division which immediately precedes it *.

The following are Mr. Hunter's observations on the 'Circulation in Insects.'

"The circulation of the blood in the insect is in itself very simple, yet from being very familiar with the most complicated, viz. that of the *Tetracoilia*, it at first might seem complicated.

"Insects cannot be said to have either pulmonary arteries or veins, having but one simple circulation; nor can they be said to have *one* aorta, but *many*, all going out from the long canal of the heart. Whatever blood is sent out from the heart in the insect is prepared blood; therefore the arteries serve the purpose of the aorta; and the veins, both of the veins in common, as also of those called pulmonary; for the common veins have the blood prepared in them, serving the purpose of pulmonary veins.

"I conceive there is a great regularity in the vascular system of the insect, although it is not easily unravelled.

"*Of the Arteries.*

"The arteries would appear to go out laterally, in a kind of plexuses †, and would appear to form the same on the stomach, &c.

"*Of the Veins.*

"The veins of the insect would appear to be simply the cellular membrane; but they are regularly formed canals, although not so distinctly cylindrical canals as in the quadruped, &c., nor branching with that regularity. They would appear to be, or to fill up, the interstices of the flakes of fat, air-cells, muscles, &c., and therefore might be called in some measure the cellular membrane of the parts *."

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* Straus Durckheim, in his Anatomy of the Cockchafer, says, that the orifices by which the venous blood is admitted to the heart, occur at these joints, and that they are provided with valves, which are so arranged as to cause the blood to flow forwards towards the head.

Anat. Descript. du Melolontha vulgaris, p. 356.

† Mr. Hunter seems here to be describing the lateral alæform ligaments of the heart, as shown in No. 896.

898 A. The heart of a Lobster (*Astacus marinus*, FABR.), with its ventral parietes removed to show the decussating muscular fasciculi, and the venous orifices in the interior of the cavity. The latter are six in number, and are each provided with a pair of semilunar valves. Black bristles are passed transversely through the four venous orifices which give passage to the blood of the general system from the great sinus surrounding the ventricle: a white bristle is placed through the orifices by which the branchial veins terminate. *Prepared by Mr. Owen.*

b. *With a Pericardium.*

898 B. Portion of an Ascidian (*Cynthia tuberculata*, OWEN), prepared to show the heart. This consists of a single elongated ventricle, which distributes the blood both over the body for the general support, and over the branchial sac for respiration. It is of a delicate membranous structure, and in the collapsed state appears as if twisted upon itself: from the size of the pericardium, it would seem capable of great dilatation. Half the branchial sac has been removed to show the vessels of that part partially injected from the heart. A white bristle is placed in the mouth, and a black one in the anus. Numerous minute ova are seen adhering to the branchial membrane. *Prepared by Mr. Owen.*

3. *Heart consisting of two Cavities, which act as a Systemic Ventricle.*

898 C. The upper lobe of the mantle of an *Orbicula* (*Orb. lamellosa*, BRODERIP), showing the branchial vessels, partially injected, and the two systemic hearts, into which bristles have been inserted by the orifices of communication with the branchial veins of the opposite mantle-lobe, which has

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* Cuvier supposed the whole of the blood of insects to be limited to receptacles of this description, and consequently denied that they possessed a true circulation, or that the dorsal tube acted as a heart. The more accurate views of Hunter, based on the analogy of the already commencing irregularity and extent of the venous sinuses in the crustaceans, have been amply confirmed by the researches of Prof. Carus, on the 'Circulation of the Blood in the Larvæ of *Ephemerides* and *Libellulæ*. See *Blutkreislaufes in den Larven netzflüglicher Insecten*, 4to, 1827.

been removed. The blood, after having been submitted to the influence of the respiratory currents in the extreme marginal ramifications of the branchial vessels, is sent by the two ventricles to the viscera and shell muscles, and from these is continued on to the mantle, without the intervention of a ventricle, or propelling organ, for the lesser circulation.

Prepared by Mr. Owen.

This type of circulation is peculiar to the Brachiopods, and though it appear more complex than that of the ordinary bivalve mollusks and Gasteropods, is essentially an inferior formation. Concentration and unity of parts characterize the superior structures; and the multiplication of ventricles having the same function is to be regarded in the same light as the multiplication of the centres of the nervous system, the division of the kidneys, &c. According to this view, therefore, the two auricles of the Muscle, having both the same functions, and receiving the same kind of blood, indicate a lower scale of formation than the heart with a single auricle, as in the Snail; and in the same way, the ten branchial sinuses of the decapod Crustaceans, and the two branchial hearts of the Cephalopods, may be considered inferior to the single branchial ventricle of fish.

4. *Heart composed of a Branchi-systemic Ventricle with two Auricles.*

899. The soft parts, injected, of a Scallop (***Pecten maximus***, LINN.). Portions of the mantle, with the pericardium, have been removed to show the heart, which is situated between the liver and the adductor muscle, and is composed of two fimbriated auricles and a ventricle. On the left side is seen the junction of a branchial vein with a systemic vein from the mantle and adductor muscle. Bristles are passed into these veins, of which the united trunk terminates in the auricle: a bristle is inserted into a corresponding vein of the opposite side.

900. The soft parts, injected, of a freshwater Muscle (***Anodon Cygneus***, Sow.), with a portion of the mantle and the pericardium dissected away to show the heart. This is of an elongated triangular form, composed of one ventricle with two auricles, both of which receive the aerated blood from the gills. The ventricle is laid open to show the rectum, or terminal part

of the intestine, passing through it in the direction of its long axis; a black bristle is placed behind the gut. The parietes of the ventricle are thickest at the lower part, or base, near which the auricles communicate with the cavity. The two orifices of communication are seen just behind the white bristle.

5. *Heart composed of a Systemic Ventricle and Auricle.*

900 A. The heart and part of the pericardium of a Bulinus (*Bul. Hæmastomus*, GUILDING). The auricle is a large globular cavity distended with the coagulated colourless blood; the ventricle is of a pyramidal form, with two semilunar valves at its base, so placed as to prevent regurgitation into the auricle. *Prepared by Mr. Owen.*

6. *Heart composed of a Systemic Ventricle, with subdivided Branchial Auricles.*

900 B. The circulation and respiratory organs of the Pearly Nautilus (*Nautilus Pompilius*, LINN.). The branchial vessels are continued from a sinus at the lower part of the vena cava. They are four in number, corresponding to the four branchiæ, and have each three clusters of glandular follicles appended to them, representing the branchial auricles. The blood, after circulating through the branchiæ, is returned by four branchial veins, which open into the four corners of a transversely oblong ventricle: this has been laid open on the opposite side of the preparation to show the columnæ carneæ within. The blood is conveyed to the system by two arteries,—one inferior and large, commencing by a muscular bulb,—the other superior and small, which is seen partially injected with quicksilver. A branch of this artery winds over the ventricle, and is continued downwards into the membranous siphon which passes through the chambered part of the shell. A portion of red silk is tied round the commencement of this membranous siphon, and a white bristle is passed through it along the pericardium, and through one of the apertures by which the pericardium communicates with the branchial chamber. It is thus that the fluid contained in the siphon has an outlet; and, on the supposition

that the chambers of the shell contain gas, the sinking and rising of the Nautilus may be regulated by the varying proportions of gas and liquid in the chambered part of the shell. *Prepared by Mr. Owen.*
See *Memoir on the Pearly Nautilus*, p. 26.

7. *Heart consisting of three separate Ventricles, one systemic and two branchial, with subdivided Branchial Auricles, contained in one Pericardium.*

901. The circulating and respiratory organs of a Cuttle-fish (*Sepia officinalis*, LINN.). The vena cava has been injected: the divisions of this vessel which convey the blood to the branchial ventricles, and may be regarded as branchial auricles, are characterized by lateral pouches, of an elongated fimbriated form and a glandular structure, but less subdivided and distinct from the vessel than in *Nautilus*. The branchial ventricles have oblong fleshy appendages hanging from them, the use of which is not known. The aerated blood is returned from the branchiæ into two auricles or sinuses, which open into the sides of the systemic ventricle. This cavity, which is distinguishable by the colour of its muscular parietes, is of an elongated, subcylindrical form, bent upon itself, and giving off one artery from the lower end, and another larger one from the opposite extremity. From the form of the ventricle, and the position of the auriculo-ventricular apertures, it would seem that the blood received from the right branchia would flow principally into the anterior aorta, and that from the left into the posterior.

902. The circulating and respiratory organs, with the stomach and pancreas, of the Cuttle-fish. The form of the follicular appendages to the branchial divisions of the vena cava is better seen in this uninjected preparation than in the preceding. White bristles are inserted into these vessels, and also into the biliary duct, from the sides of which the pancreatic follicles are continued in a manner somewhat similar to that of the appendages to the veins. The laminated spiral cæcum has been laid open to show the termination of the biliary duct, in which a white bristle is placed.

902 A. The circulating and respiratory organs of a Calamary (*Onykia Banksii*, LEACH). In this species, as in the Cuttle-fish, the divisions of the *vena*

cava which carry the blood to the branchial ventricles are glandular, and these ventricles are provided with fleshy appendages. The branchial veins do not, however, form sinuses; and the systemic ventricle is of a different shape from that of the Cuttle-fish. It is rhomboidal, with the long diameter in the axis of the body; gives off the two aortæ by the anterior and posterior angles; and receives the branchial veins by the lateral ones: these, however, are not on the same plane, the right being more anterior than the left. *Prepared by Mr. Owen.*

903. The systemic ventricle, laid open, of a large Cephalopod (*Onykia* —— ?).

In this preparation may be seen the arrangement of the muscular fibres, which are disposed in different planes, and decussate each other obliquely. The auriculo-ventricular apertures are guarded each by two semilunar valves, and the arterial orifices are provided with two similar but smaller valves. The right auriculo-ventricular aperture may be observed to be on a plane anterior to the left, and the form of the entire ventricle to correspond closely with that of the preceding species.

From this correspondence it may be inferred, that the present preparation once formed part of a large Onykia, or Cephalopod with arms provided with hooks instead of suckers; and the supposition is strongly corroborated by the fact of there being several parts of a gigantic species of this genus of Cephalopod in the Collection, viz. the caudal extremity of the trunk with the rhomboidal fin; two portions of an arm, the acetabula of which are provided with hooks; and a beak corresponding in size to these several parts.

8. *Heart consisting of two Cavities, a Branchial Ventricle and Auricle.*

904. The heart of a Frog-fish (*Lophius piscatorius*, Linn.). The blood, which has circulated over the body, is conveyed to the heart by large veins, or sinuses, which unite just at their termination in the auricle; and this orifice is guarded by two large semilunar valves, which prevent regurgitation into the veins. The auricle is of ample size, and reticulated internally by decussating fasciculi of muscular fibres: it opens into the side of the ventricle, and the orifice of communication is guarded by two se-

milunar valves, which are smaller and stronger than those at the termination of the veins. The ventricle, in this species, is of an oval form; and the cavity small, in proportion to the thickness of the muscular parietes. The branchial artery is dilated and muscular for about an inch from its commencement, forming what is termed the *bulbus arteriosus*. The semilunar valves are confined to the base or commencement of the bulb, and are two in number: beyond these valves the bulb is fasciculated internally, and principally in the longitudinal direction. The branchial artery divides into three branches immediately beyond the bulb, one of which, after a short course, again subdivides.

This beautiful preparation is called in the folio MS. Catalogue "The heart of the 'Frog-fish,'" and it resembles in every respect the heart of a *Lophius piscatorius*, dissected for the purpose of comparison. In both specimens the bulb was provided at its commencement with two semilunar valves, and had no muscular tube projecting into it, as described by Sir Everard Home, *Phil. Trans.* ciii. (1813.) p. 234.

905. The heart of a Sun-fish (*Orthagoriscus Mola*, SCHNEIDER). The auricle has been laid open to show the two large semilunar valves at the termination of the veins: it is much fasciculated internally. The ventricle has the four-sided shape which most commonly obtains in osseous fishes: both the aperture of the auricle and that of the branchial artery are situated on the anterior surface. The auricular aperture is guarded by four membranous valves, two small semilunar valves being placed at right angles with, and on the auricular side of, the two large and ordinary semilunar valves. The commencement of the bulbus arteriosus is similarly guarded by four semilunar valves. The bulb is pyriform, and marked with longitudinal ridges externally: it is more muscular than in the preceding species, but similarly fasciculated internally. The branchial artery extends for some distance before giving off the branches to the gills.

906. A longitudinal section of the branchial artery of a Wolf-fish (*Anarrhicas Lupus*, LINN.), showing the muscularity of the bulb, and the two semilunar valves at its base.

907. A section of the venous sinus and auricle of the heart of a Sturgeon (*Aci-*

penser Sturio, Linn.), showing the two semilunar valves which are placed at the orifice of communication between these cavities, and which prevent regurgitation taking place into the sinus when the auricle contracts; for as the blood presses upon the valves, they present a proportionate degree of resistance, from the attachment of their extremities to the principal muscular fasciculi of the auricle.

908. The auricle, ventricle, and branchial artery of the same heart. The auriculo-ventricular valve resembles a tricuspid valve of the mammiferous heart, having numerous chordæ tendineæ attached to its margin and ventricular surface. The ventricle has a very irregular external surface, and strong muscular parietes. The muscular coat of the bulbus arteriosus is more distinct from the elastic coats of the artery than in the previous specimens. There are three series of semilunar valves, two at the commencement, and the third at the termination of the bulb: the latter are the largest and most perfectly formed. Those at the base are much thickened at their margins, which are attached to the parietes of the bulb by small chordæ tendineæ. The number of these valves is in the lower row *four*, in the second row *four*, and in the third row *five*. A bristle is placed in one of the coronary vessels.

909. The ventricle and bulbus arteriosus, laid open, of a Skate (*Raia Batis*, Linn.). The thickness of the ventricular parietes and the fasciculated arrangement of the muscular fibres are well displayed in this specimen. The bulb of the branchial artery is provided with five rows of semilunar valves, which increase in size to the last row, which is at the termination of the bulb.

910. The heart of the American Devil-fish* (*Cephalopterus Giorna*, Cuv.). The auricle and ventricle are laid open, showing the two large semilunar valves at the termination of the venous sinus, and the two smaller valves at the auriculo-ventricular aperture. From this aperture the cavity of

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* Mr. Hunter calls it the "Sea Devil, or Kingston Skate." It is probably the same species as that described by Dr. Bancroft of Jamaica, (Zool. Journal, iv. p. 453,) under the name of *Cephalopterus Manta*.

the ventricle at first extends horizontally, and then bends upwards to the commencement of the branchial artery.

The bulbus arteriosus is of an oblong form and of great extent, its cavity being larger than that of the ventricle itself. It is surrounded by a strong and distinct investment of muscular fibres. It presents internally three longitudinal angular ridges, which support as many semilunar valves at the termination of the bulb. In the interspaces of the ridges, the internal surface of the bulb is delicately reticulated, the interspaces being largest next the columns, and with the orifices directed towards the artery. About one third from the ventricle these spaces assume the form of small valves, two of which correspond to each column. Two other rows of valves may be distinguished below the preceding, the largest being at the commencement of the bulb.

911. The ventricle and bulbus arteriosus, laid open, of the Grey Shark (*Galeus communis*, Cuv.). The auriculo-ventricular aperture is guarded by two semilunar valves, which have not chordæ tendineæ attached to them as in the Sturgeon. The ventricle is proportionately more muscular, but the bulbus arteriosus is much smaller and weaker than in the preceding specimen. It is smoother on the inner surface, and is provided with two rows of three valves each. Those of the upper row, which are at the extremity of the bulb, are the largest, and have their upper margins free, while those of the lower row have a tendinous chord passing from the middle of this margin to the base of the valve above.

911 A. The heart of a Skate (*Raia Batis*, Linn.), injected with size and vermilion, showing the form and relative position of the auricle, ventricle, and bulbus arteriosus. The trunk of the branchial artery sends off four branches, two at the end of the bulb, which supply the three posterior pairs of gills, and two formed by the bifurcation at its extremity, which supply the two anterior pairs of gills. *Prepared by Mr. Clift.*

911 B. The heart, similarly prepared, of a Conger Eel (*Conger vulgaris*, Cuv.). From the thinness of the parietes of the auricle, the colour of the injection is seen through them. The bulbus arteriosus is pyriform, and the branchial artery, from the peculiar form of the fish, is of great length: it sends

off six branches, the first two of which divide to supply the two posterior pairs of gills; the two anterior pairs receive the remaining branches.

Prepared by Mr. Clift.

911 c. The heart, similarly prepared, of the Fox-Shark (*Carcharias Vulpes*, Cuv.). The bulbus arteriosus is smaller in proportion than in either of the preceding species. The branchial artery gives off eight branches, the last pair dividing to supply the two anterior pairs of gills, the number of which is the same as in the Skate, viz. five on each side; whilst in the Conger and other osseous fishes there are only four pairs of gills.

Prepared by Mr. Clift.

9. *Heart composed of three Cavities, viz. two Auricles and one Ventricle; one Auricle receiving the Blood from the Lungs, the other the Blood from the general System.*

912. The anterior part of the body of a Siren (*Siren lacertina*, Linn.). The ventral parietes have been removed, together with the pericardium, to show the heart *in situ*. It is of an elongated form, and consists of a large fimbriated auricle, divided internally into two chambers, and of a flattened oblong ventricle, giving off a single artery, which, after a half spiral twist, dilates into an elongated fleshy bulbus arteriosus.

The blood from the body passes into a large membranous sinus formed by the union of the two anterior venæ cavæ with the large posterior cava. The latter vessel pours its blood into the sinus by two orifices on either side a septum, which extends forwards as far as the openings of the anterior cavæ, where it terminates in a free semilunar margin; the sinus is then continued forwards, and terminates in the chamber analogous to the right auricle. White bristles pass from the posterior cava through the sinus on either side the septum into the anterior cavæ. A black bristle is passed through the right pulmonary vein into the trunk common to the two, which traverses, but does not communicate with, the sinus proper to the veins of the body, and terminates in the chamber analogous to the left auricle.

The *bulbus arteriosus* is laid open, to show the valvular protuberance which projects into it from the dorsal aspect. On the opposite side of the preparation, the cranium and upper jaw are removed to show the apertures leading from the mouth to the lungs and gills, the simultaneous existence of which, through life, forms the chief characteristic of this tribe of truly amphibious reptiles.

913. The heart of a Siren. The auricle, consisting of the two chambers, as above mentioned, appears as one cavity externally. It is remarkable for its large size, its weak parietes, and the number of fimbriated follicular processes which it sends off, and which give it an appearance similar to the branchial divisions of the vena cava in the cephalopods. The ventricle is here seen to be slightly bifid at the apex. The artery is membranous at its commencement. The bulb is here laid open to show the internal valvular projection.

913 A. The heart and pericardium of a *Siren lacertina*, prepared to show the internal structure of the auricles and ventricle.

White bristles pass from the veins of the body into the right auricle, and black ones through the pulmonary veins into the left auricle. This is much smaller than the right auricle, corresponding to the quantity of blood which it receives. The pulmonary veins unite into a common trunk, which seems to pass through the great sinus of the veins of the body, but it adheres to the parietes of that sinus by its posterior surface. It is probably this remarkable structure which led Mr. Hunter to suppose that the sinus was part of the pericardium, and that the venæ cavæ opened into it. His description of the heart of the Siren is as follows:

" The heart consists of one auricle and one ventricle. What answers to the inferior vena cava passes forwards above, but in a sulcus of the liver, and opens into a bag similar to the pericardium: this bag surrounds the heart and aorta as the pericardium does in other animals; from this there is an opening into a vein which lies above, and upon the left of the auricle, which vein seems to receive the blood from the lungs, gills, and head, is analogous to the superior vena cava, and opens into the auricle, which is upon the left of the ventricle. The aorta goes out, passing for a little way in a loose spiral turn, then becomes straight, where it seems to be muscular: at this part the branches go off, between which there is a rising within the area of the aorta like a bird's tongue, with its tip turned towards the heart.

"This account of the venæ cavæ opening into the cavity of the pericardium may appear incredible; and it might be supposed that, in the natural state of the parts, there is a canal of communication going from one cava to the other, which being broken or nipt through in the act of catching or killing the animal, would give the appearance above described. I can only say that the appearances were what have been described in three different subjects which I have dissected, and in all of them the pericardium was full of coagulated blood. But besides the smallness of the subjects, it may be observed, that they had been long preserved in spirits, which made them more unfit for anatomical inquiries.

"They had been in my possession above seven years."

Hunter, *Phil. Trans.*, vol. lvi. (1766,) p. 308.

All anatomists since Mr. Hunter's time have concurred in ascribing but one auricle to the heart of the Siren; and Cuvier regards this simple structure of the central organ of the circulation as common to the Batrachian order of reptiles. The outward form of the auricle naturally suggests such an idea, and it is only in favourable specimens that the true structure, as it is shown in this preparation, can be made out. The pericardium is here seen to be composed of a strong fibrous membrane, smooth and glistening on its internal surface, and adhering by the whole of its outer surface to the surrounding parts. The ventricle is connected to the pericardium, not only by the reflection of the serous layer from the bulbus arteriosus, but by a duplicature of the same membrane, which passes from the lower third of the posterior edge of the ventricle, and incloses the coronary vein: this vein is continued from the apex of the ventricle to the sinus. The muscular parietes of the ventricle are about a line in thickness, and of a loose fasciculate structure. The cavity is partially divided by a rudimentary septum, which extends from the apex half way towards the base of the ventricle, and there terminates in a concave edge directed towards the orifice of the artery. The whole inner surface is reticulated by decussating carneæ columnæ, one of which has been detached from its connexion to the septum, which intervenes to the two auricular apertures, and which supports the valvular structure that closes them from within. The artery and bulbus arteriosus are laid open, showing in the latter the remarkable valvular projection described by Mr. Hunter. The vessels on the back part of the talc which supports the preparation are, the inner ones, the pulmonary arteries; the outer ones, the jugular veins, or anterior cavæ. *Prepared by Mr. Owen.*

914. The anterior part of the body of a large *Siren lacertina*, prepared to show the heart and principal vessels, which have been injected. The fimbriated structure and magnitude of the auricles are well seen when thus distended, and they then advance forwards on both sides of the ventricle and bulb, so as almost to encompass those parts. The two divisions of the venous sinus may be observed below the ventricle, with the termination of the coronary vein, and the attachment of the ventricle to the sinus. Behind the ventricle are the two superior cavæ, which terminate at the sides of the sinus. The portions of the lungs which remain are laid open to show their reticulate structure, and the relative positions of the pulmonary arteries and veins: white bristles are placed in the former, and black ones in the latter vessels. On the left side of the preparation, the origin of the pulmonary artery, from the posterior branchial arch, is shown. The remainder of the branchial vessels, with the exception of small branches to the head, are collected into one trunk, which unites with the corresponding vessels of the opposite side to form the aorta or systemic artery.

The tongue, the interior of the air tube, the internal branchial apertures, and the branchiæ of the left side, the eye and nostril, and structure of the integument are also favourably displayed in this preparation.

915. The anterior part of the body of an Amphiuma (*Amph. means*, Garden), prepared to show the heart and great vessels *in situ*.

The blood is returned from the body, as in the preceding species, by two anterior venæ cavæ and one large posterior cava, which form by their union a membranous sinus. The auricles or venous chambers of the heart are proportionately smaller and less fimbriated, and are situated more to the left and superior part of the ventricle. The ventricle is connected to the pericardium at its apex, and gives off from its opposite extremity a single artery, which, after a half spiral turn, dilates into a large bulb, which is broader and shorter than in *Siren lacertina*, and is grooved externally. The two pulmonary arteries are given off from the posterior part of the extremity of the bulb, which then divides into two branches each of which again subdivides on the side of the œsophagus. As there are no external gills, so there are no lateral branches sent off from the branchial arteries; but these, after winding round the arches of the hyoid bone, terminate in a single trunk on either side, and form by their union the aorta, which is seen, injected, behind the pharynx.

On the left side of this preparation the internal branchial aperture is preserved, and on the right side the branchial arches of the hyoid bone are shown. The lungs are laid open so as to display their reticulate and longitudinally plicate structure, and the relative positions of the pulmonary arteries and veins.

This preparation is figured by Rusconi (*Amours des Salamandres Aquatiques*, pl. v. fig. 8.) as a portion of the adult *Siren lacertina*, which he supposes to have lost the external branchiæ, and to have acquired the posterior extremities in a manner analogous to the Salamanders; and he endeavours to invalidate the opinion which Mr. Hunter, after an extensive and minute comparison of their entire structure, had formed of the specific difference of the Amphiuma and Siren, as well from each other as from the Kattewagoe, or *Menopoma* of Harlan.

The manuscript to which Rusconi alludes, contains detailed accounts of the anatomy of *Amphiuma*, Cuv., and *Menopoma*, Harlan, as well as of the *Siren*, which latter Mr. Hunter has published in the volume of the Philosophical Transactions above quoted; the former will be given entire in the descriptions of the plates illustrative of the present volume. The conclusions as to the distinctions of these amphibia, to which the illustrious Founder of our collection arrived, have been subsequently confirmed by a similar series of investigations instituted by Cuvier.—See his *Mémoire sur les Reptiles douteux*, in the ‘Recueil des Obs. Zoologiques, faisant Partie du Voyage de Humboldt.’

916. The lower jaw, tongue, fauces, with part of the abdominal viscera, and the heart *in situ*, injected, of a Menopoma (*Men. Alleghaniensis*, HARLAN).

The greater part of the pericardium has been removed. The ventricle is of a flattened triangular form, resembling that of osseous fishes: the auricles are smaller in proportion than in the Siren, and are situated wholly to the left of the ventricle. The veins of the body terminate in a membranous sinus situated below the auricles.

The aorta, after making a spiral turn to the left side, dilates into a large bulb, which gives off four vessels on each side. The first or posterior pair are the smallest, and ramify on the œsophagus and lungs: they are not distinctly shown in this preparation. The second and third pairs are the largest: they are seen passing outwards, and winding round the arches of the hyoid bone. The two branches unite on either side, and after sending off small arteries to the head, converge on the posterior part of the œsophagus, and unite to form the descending aorta. The fourth small pair of arteries pass outwards, and wind over the anterior part of the first hyoidean arch: they send off in this course some small arteries to the head, and ultimately unite with a cephalic branch given off from the united trunk of the third and second branchial arteries.

The right lung is preserved in this preparation; a black bristle is inserted into it from the trachea. White bristles are placed in the right branchial aperture, which is left entire, showing the absence here, as in *Amphiuma*, of external gills. On the left side the branchial arches of the hyoid bone are preserved.

Besides the parts concerned in the circulatory and respiratory functions, there are also well displayed in this preparation the stomach, duodenum, liver, prancreas and spleen.

917. The heart, pericardium, and trachea of the *Menopoma Alleghaniensis*. The ventricle is laid open to show the loose, fasciculate, muscular structure, which, as in the *Testudo Indica*, occupies the whole of its cavity. The bulb of the aorta is laid open to show the two rows of semilunar valves, three in each row, and the origins of the branchial arteries. The preparation is suspended by the pericardium, behind which is the flattened air tube, in which distinct cartilaginous rings cannot be distinguished.

917 A. The heart of the Surinam Toad (*Pipa monstrosa*, Laurenti), showing the large size of the auricles, the rounded form of the ventricle, and the junction of the two aortæ which, at an early period of existence, distributed the blood to lateral branchiæ, as in the preceding reptiles.

Prepared by Mr. Owen.

917 B. The heart of a Serpent (*Python Tigris*, Daud.), prepared to show the internal structure as well as outward form.

The blood of the general system is collected into a large elongated sinus, formed by the union of the inferior with the right superior cava. The left superior cava winds round the back of the left auricle, receives the coronary veins, and terminates in the lower part of the orifice which leads from the above sinus to the right auricle. This orifice is protected by two elongated semilunar valves. The whole of the inner surface of the auricle, with the exception of these valves and the opposite valve of the foramen ovale, is reticulated with delicate muscular fasciculi. The left auricle receives the blood from the lungs by a single pulmonary vein, and has a similar reticulated muscular structure: there is no valve at the termination of the vein in this auricle. The blood enters the posterior or aortic division of the ventricle by two crescentic apertures, which are each provided with a single semilunar valve, extended from either side of the septum of the auricular orifices. The irregular form and small size of the aortic chamber is shown by the removal of the posterior parietes of the ventricle. On the opposite side, the pulmonary chamber is exposed: it is of a larger size, with a smoother surface, and is of a more regular oval form. The fleshy septum, which extends from the base of the ventricle to the space between the roots of the pulmonary and systemic arteries, is incomplete at its upper and anterior part, and leaves there a free communication between the pulmonary and aortic chambers: these also intercommunicate by several round apertures of different sizes near the apex of the ventricle, which serve to thoroughly blend together the two kinds of blood before they are expelled, thus mixed, along the three arteries which separately arise from the ventricles. In this preparation the origins of the pulmonary artery and left aorta only are shown. They are each provided with a pair of semilunar valves. The carotid arteries are given off from the right aorta, which afterwards unites with the left aorta at some distance below the heart. The gland, analogous to the thymus, is here preserved: its structure is cellular.

White bristles are passed through the systemic veins, sinus and auricle; and a black one through the pulmonic vein and auricle. The two branches of the pulmonary artery, which go to the two separated lungs in this species of serpent, are distinguished by black bristles, which also indicate the situations of the two ductus arteriosi. *Prepared by Mr. Owen.*

918. The liver, stomach, bronchi, heart and great vessels of the Europæan fresh-water Tortoise (*Emys Europæa*, SCHŒPFFER).

This preparation shows the two lobes of the liver united by a very thin strip below the heart; and the left lobe, like the lobulus Spigelii of quadrupeds, adapted to the lesser curvature of the stomach. The anterior part of the pericardium has been removed to show the form of the heart. The ventricle is of a transversely oblong figure: the two auricles rest upon its basis posterior to the three arteries, which arise close together, and are united for some way from their origins by dense cellular membrane. The right and posterior artery gives off the carotid and brachial arteries, and its trunk is continued over the right bronchus to the posterior part of the abdomen: the middle vessel, as in the snake, winds over the left bronchus, and joins the opposite aorta in the abdomen. The left vessel is the pulmonary artery; its two branches communicate in the fœtus with the two aortæ by two ductus arteriosi, and afterwards are exclusively distributed to the lungs. The bronchial tubes, owing to the high division of the trachea, are of great length in the Tortoise.

919. The heart of a Turtle* (*Chelonia Mydas*). The auricles are laid open so

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* "This is a mixture between the first and third (kinds of hearts), by which means it is more imperfect and much less distinct than either. This heart consists of two distinct cavities, and two others which are not so perfectly distinct, and act only as one cavity. The two distinct cavities are the auricles, but the ventricles have such an imperfect septum, that it reduces the two into one. The veins of each auricle enter distinctly as in the first division of hearts; but the arteries arising from this mixture of ventricles are more complicated. They are not exactly the same as to anatomical structure in all of this class, although much the same as to use, producing nearly the same effect in all of them.

"To give an idea of this we shall describe them in the Turtle, which will sufficiently explain their use in all the others." *Hunterian MS. Catalogue.*

as to show the complete septum by which they are separated, and the loose cellular and reticulate muscular structure of their parietes. Two large semilunar valves are placed between the sinus and the right auricle: a white bristle is inserted between these. A quill is passed through the auricular aperture into the chamber from which the two aortæ arise. This cavity is separated from the pulmonary chamber by a strong but imperfect muscular septum, as in the Python. A black bristle is passed from the left auricle into the ventricle; white bristles through the different apertures of communication between the ventricular chambers. The two kinds of blood, after being thoroughly blended by being infiltrated through the several spaces formed by the decussating fasciculi of the muscular columns of the ventricle, are then propelled along the three arteries to the body and to the lungs. These arteries have the same relative positions as in the Emys and Python: they are laid open at their origins to show the two semilunar valves in each. Part of the attaching process of the pericardium is left adhering to the apex of the ventricle.

920. The ventricle of the Indian Tortoise (*Testudo Indica*, Vosmaer). The chamber with which both auricles communicate, and from which both aortæ take their origin, extends transversely across the base of the ventricle. The pulmonary chamber extends obliquely from the base of the artery to the apex of the ventricle, and is separated from the preceding by an imperfect muscular septum. These chambers are of small size compared with the bulk of the ventricle, which is everywhere else occupied by a spongy muscular structure. The pulmonary chamber communicates with this spongy structure by large orifices at its lower part, as in the heart of the *Chelonia Mydas*.

Red bougies are placed in the two aortæ, and a brown one in the pulmonary artery, which has a reticulate internal surface. At the posterior part of the preparation the two auricular orifices are shown, and the valvular folds which extend across them from either side of the intervening septum. A slightly projecting semilunar ridge extends from the opposite side of the right auricular aperture: this is the rudiment of the fleshy valve which guards the same aperture in birds.

921. The heart of a Crocodile (*Crocodilus acutus*, Cuv.). The auricles are

larger than the ventricles; they are more distinct from each other, and their appendices extend further forward than in the Chelonian reptiles. The right auricle is here laid open, showing the two semilunar valves placed to prevent regurgitation into the sinus. The aperture of communication with the ventricle is also provided with two semilunar valves. The left auricle is laid open, showing its complete separation from the one on the right side: a black bristle is passed from the united trunk of the pulmonary veins through the auricle into the left or aortic chamber of the ventricle. The arteries, which are three in number, as in the Python and Chelonia, are cut off near their origins, and are laid open to show that they are each provided with a pair of semilunar valves.

921 A. The heart of a Crocodile (*Croc. acutus*). In this preparation the two superior and the inferior venæ cavæ are seen terminating in the sinus: the two semilunar valves placed at the passage into the auricle, and the delicate reticulate muscular structure of the auricular parietes are also shown.

The pulmonic chamber of the ventricle includes, not only the orifice of the pulmonary artery, but also that of the left aorta; and the venous blood from the right auricle is poured into it, in consequence of the septum at the base of the pulmonary artery, which was incomplete at the upper part in the preceding specimens, extending here to the base of the ventricle between the two aortæ and the two auricular orifices. All communication between the pulmonic and systemic chambers at the base of the ventricle is consequently cut off; but the septum is perforated by several apertures towards the apex, through which the arterial and venous blood may become mingled together. To prevent in some degree this admixture, a valvular fold is continued from the left semilunar valve of the right auricular aperture, and is partially extended across the largest of the perforations. On the right side of the auricular aperture is another and smaller valve, which is muscular and more developed than in the heart of the Tortoise: its analogy with the muscular valve of the right ventricle in birds will be readily perceived by comparing this preparation with that of the heart of the Ostrich, No. 923. The pulmonary artery arises at the left side of the base of the ventricle. The left or visceral aorta is here seen to be, as it were, encroached upon by the right aorta, so that its area presents a semilunar form. On the opposite side of this preparation, the left auricle and ventricle are laid open: the aperture of intercommunication is guarded by a single membranous fold. A black bristle is passed into the aorta, which, after distributing the arterialized blood to the head and upper extremities, passes over the right bronchus into the abdomen, and receives a small branch of communication from the left aorta. A process of serous membrane, including a coronary vein, is continued from the apex of the ventricle to the pericardium, as in the Siren, the Turtle, and the Tortoise. *Prepared by Mr. Owen.*

922. The heart and principal vessels of a small Crocodile. The bend of the trachea, and the two superior *cavæ* are preserved in this preparation. A brown bristle is passed through the pulmonary artery, a white one through the left aorta, and black ones into the different branches of the right aorta. The two valves of the right auriculo-ventricular aperture, and the orifices of communication at the apex of the left, are also shown in this preparation.

10. *Heart composed of four Cavities, viz. a Pulmonary Auricle and Ventricle and a Systemic Auricle and Ventricle.*

" *Of the first division of Hearts.*

"Each body called heart is formed of two distinct hearts, each having its auricle and ventricle, with distinct veins opening into the auricle, and each ventricle its artery passing out.

"Although the above division is true, and from thence it might be conjectured that there was no connexion between the two circulations, yet nature has connected them by means of the viscus, viz. the veins corresponding with the arteries of the right side, shift sides and go to the left, and *vice versâ* of the left side. The valves are similar in all."

Hunterian MS. Catalogue.

a. *In Birds.*

923. The ventricles of the heart of an Ostrich (*Struthio Camelus*), laid open to show the valves at the auricular and arterial orifices. In the right ven-

tricle the auricular orifice is guarded by two valves, as in the Crocodile; but the one on the right side is here much the largest, and both valves are muscular. A single artery, the pulmonic, arises from this ventricle, there being no vessel analogous to the visceral or left aorta of reptiles: its orifice is provided with three semilunar valves.

The left auricular aperture is provided with two membranous valves, that on the right side of the orifice, which corresponds to the single valve in the Crocodile, being the largest. The orifice of the aorta, which is situated directly behind that of the pulmonary artery, and, as it were, on the top of the septum, is provided with three semilunar valves. The muscular parietes of the ventricles are dense and compact; those of the left are of extraordinary thickness: the right ventricle is remarkable for the smoothness and evenness of its inner surface.

923 A. A transverse section of the ventricles of the heart of an American Ostrich (*Rhea Americana*), showing the relative thickness of their muscular parietes and their different form, the right appearing to be composed of a partial separation of some of the exterior fibres of the left ventricle.

Presented by Sir E. Home, Bart.

923 B. The heart of an Emeu (*Dromaius Novæ Hollandiæ*), prepared chiefly to show the structure of the auricles. The veins of the body terminate, as in reptiles, by three principal trunks, which, with the coronary vein, unite to form a membranous sinus. Two fleshy semilunar valves are situated at the communication of the sinus with the auricle: they are fixed by their lower extremities to the floor of the auricle, but attached by the opposite ends to strong fleshy columns, which afterwards branch out into the musculi pectinati. The inferior valve is analogous to the Eustachian valve in the heart of mammalia. The left superior cava opens into the sinus below the orifice of the inferior cava, and a small semilunar fold or valve intervenes between them. Whatever impediment, therefore, there may be to the free passage of the venous blood through the respiratory system, regurgitation from the auricle to the venous sinus is as carefully guarded against as in the Reptilia. The two pulmonary veins unite, and terminate by a single trunk in the left auricle: a large semilunar fold

separates the muscular part of the auricle from the vein. The ventricles are laid open, showing on the right side the two fleshy valves, and on the left the two membranous valves placed at the auriculo-ventricular orifices. Of the great vessels arising from the heart, the left and most anterior is the pulmonary artery; the two next are the left and right arteriæ innominatæ, each giving off the carotid and subclavian of its corresponding side; the fourth vessel is the aorta, which winds over the right bronchus, like the right aorta in Reptilia. *Prepared by Mr. Owen.*

b. *In Mammals.*

923 c. The heart of a Kangaroo (*Macropus major,* SHAW). In this and all the other marsupial animals the blood is returned from the head and atlantal extremities by two distinct superior cavæ, as in the oviparous vertebrata. The auricle is laid open to show that there is no valvular apparatus between the sinus and auricles, as in birds, the respiration of the Kangaroo being similar to that of other mammalia. The left superior cava receives the coronary vein, and joins the inferior cava just before its termination in the auricle. There is a salient angle between the superior and inferior cavæ, but no trace of a fossa, or annulus ovalis in consequence of the premature birth and early exercise of the lungs in this animal. The right auricle has two appendices, one in front and another behind the trunk of the aorta. The right ventricle is laid open to show its limited extent compared with the left, and the membranous texture of the auriculo-ventricular valve; the same force not being here required or exerted in propelling the blood to the respiratory organs as in birds. *Prepared by Mr. Owen.*

923 D. The heart of a Porcupine (*Hystrix cristatus,* LINN.). In this, and many other quadrupeds of the rodent order, the blood is returned to the right auricle in the same manner as in the Marsupiata, viz. by two superior venæ cavæ and one inferior. A large inferior or Eustachian valve is placed at the auricular side of the orifice of the inferior cava, and a very slight ridge indicates the remains of the superior valve or boundary of the venous sinus. Both ventricles are laid open, showing the membranous valves which determine the direction of the blood, and the tendinous chords inserted into their margins to prevent their retroversion into the auricles

during the systole of the heart. The vestige of the single ductus arteriosus is preserved. *Prepared by Mr. Owen.*

924. A section of the right auricle and ventricle of an Elephant (*Elephas Indicus*, Cuv.). In this animal, which in some other respects singularly resembles the Rodentia, three venæ cavæ terminate in the right auricle. Besides the Eustachian valve, which projects between the orifices of the inferior and left superior cavæ, there is also here, as in the Porcupine, a rudiment of a superior valve extending from the posterior side of the orifice of the right superior cava. The tricuspid valve, and its chordæ tendineæ and columnæ carneæ, are also well displayed in this specimen.

925. The appendix of one of the auricles of the Bottle-nose Whale (*Delphinus Dalei*, Cuv.), showing on a large scale the fleshy bundles, called musculi pectinati, which assist in propelling the blood from the auricle into the ventricle.

926. A larger portion of the right auricle of the same Whale.

927. A portion of the left ventricle of the same Whale, showing the mitral valve and auriculo-ventricular orifice. The chordæ tendineæ are seen to be attached not only to the margin, but to the ventricular surface of the valves.

The following is Mr. Hunter's description of the heart of the Whale:

"The heart is inclosed in its pericardium, which is attached by a broad surface to the diaphragm, as in the human body. It is composed of four cavities *,—two auricles and two ventricles: it is more flat than in the quadruped, and adapted to the shape of the chest. The auricles have more fasciculi, and these pass more across the cavity from side to side than in many other animals; besides, being very muscular, they are very elastic, for being stretched they contract again very considerably. There is nothing uncommon or particular in the structure of the ventricles, in the valves of the ventricles, or in that of the arteries.

"The general structure of the arteries resembles that of other animals;

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* "As the circulation is a permanent part of the constitution respecting the class to which the animal belongs, and as the kind of heart corresponds with the circulation, these should be considered in the classing of animals. Thus we have animals whose hearts have only one cavity, others with two, three, and four cavities."

and where parts are nearly similar, the distribution is likewise similar. The aorta forms its usual curve, and sends off the carotid and subclavian arteries...... In our examination of particular parts, the size of which is generally regulated by that of the whole animal, if we have only been accustomed to see them in those which are small or middle sized, we behold them with astonishment in animals so far exceeding the common bulk as the Whale. Thus the heart and aorta of the Spermaceti Whale appeared prodigious, being too large to be contained in a wide tub, the aorta measuring a foot in diameter. When we consider these as applied to the circulation, and figure to ourselves that probably ten or fifteen gallons of blood are thrown out at one stroke, and moved with an immense velocity through a tube of a foot diameter, the whole idea fills the mind with wonder.

" The veins, I believe, have nothing particular in their structure, excepting in parts requiring a peculiarity, as in the folds of the skin on the breast in the Piked Whale, where their elasticity was to be increased."

Hunter, On Whales. Phil. Trans. lxxvii. p. 414.

927 A. The heart of a Porpesse (*Phocæna communis*, Cuv.). Prepared to show the tricuspid and mitral valves, and the structure of the auricles. The foramen ovale is completely closed; and there is no trace of an Eustachian valve in the right auricle. The ductus arteriosus is so far obliterated as to admit of the passage of a small bristle only. *Prepared by Mr. Owen.*

928. The heart of an Ass (*Equus Asinus*, Linn.), with the several cavities laid open to show their internal structure. In the right auricle is seen the projection above the fossa ovalis, between the superior and inferior cavæ, called the tuberculum Loweri, and also, in the human subject, the Isthmus Vieussenii. Below the orifice of the inferior cava, is that of the coronary vein, but there is no trace of an Eustachian valve. The right ventricle differs from that of the human heart in its greater smoothness, and in the less quantity of the carneæ columnæ. The valve at the auricular orifice consists of three distinct membranous folds. On the left side of the heart, the valve between the auricle and ventricle consists, as usual, of two membranous folds. The aorta and pulmonary artery are laid open so as to show the three semilunar valves at the origin of each.

929. The human heart prepared to show the form and structure of its different cavities. In the right auricle are shown the terminations of the superior and inferior cavæ, and of the coronary vein, which latter, from the different disposition of the left superior cava, or vena innominata, terminates in the auricle by a distinct orifice, having the same relation with the orifice of the inferior cava as that of the left superior cava holds to the same vessel in Birds, Marsupiata, &c. A large reticulate Eustachian valve, the analogue of the inferior valve of the venous sinus in the Ovipara, is here seen intervening to the orifices of the inferior cava and coronary veins. In this auricle may also be noticed the annulus and fossa ovalis, the appendix and musculi pectinati, and the valve of the coronary vein. In the right ventricle the tricuspid valve, and the mechanism which ensures its due action in resisting the reflux of blood into the auricle, are well displayed; as also the smoothness of the ventricle below the origin of the pulmonary artery to facilitate the passage of the blood in that direction, and the three sigmoid valves which prevent its return. In the left auricle, the terminations of the four pulmonary veins and the muscular structure of the appendix are shown; and in the left ventricle the mitral valve, the large size of the columnæ carneæ, and the thickness of the parietes of the ventricle.

930. A portion of the right auricle and inferior cava, with a large and loosely reticulated Eustachian valve of the human heart.

931. A longitudinal section of the human heart, showing the septum of the auricles and ventricles; the Eustachian valve, which is large and fleshy; the valve of the coronary vein; and portions of the tricuspid and mitral valves; with the chordæ tendineæ and columnæ carneæ of the ventricles.

932. The opposite section of the same heart, showing the appendices of the auricles; the origins of the arteries and their semilunar valves; the isthmus Vieussenii, or upper part of the annulus ovalis; and a portion of the valve of the foramen ovale.

933. A portion of the left ventricle of the human heart, prepared to show the mitral valve, and the two large columnæ carneæ, to which the chordæ tendineæ are, in general, principally attached. The largest fold is that which

is nearest the septum of the ventricle, and is the only one which exists at the corresponding orifice in the heart of Reptiles.

934. A transverse section of the human heart, showing at one view all the valves on which the due performance of its function depends. The mode of action of the auriculo-ventricular valves, in preventing a return of blood into the auricles, and of the sigmoid valves, in preventing a return of blood into the ventricles, can be readily understood by this preparation.

934 A. The trunk of a human fœtus injected and prepared, to show the relative positions and attachment of the heart and pericardium.

Presented by Wm. Lawrence, Esq., F.R.S.

SERIES III. Structure of Arteries.

1. *Valves of Arteries.*

935. The origin of the aorta of the human subject, prepared to show the three sigmoid or semilunar valves, thrown inwards, as in the act of sustaining the pressure of the blood during the diastole of the ventricles.

936. The origin of the pulmonary artery of the Bottle-nose Whale (*Delphinus Dalei*, CUV.), showing the semilunar valves, and the dilatations above them, called the sinuses of Valsalva.

See Mr. Hunter's Observations on the action of these valves; the use of the corpora sesamoidea, and the differences which they present in the aorta and pulmonary artery, in the 'Treatise on the Blood,' 4to, p. 159.

936 A. The origin of the branchial artery, or *bulbus arteriosus*, of the Basking Shark (*Selache maxima*, CUV.), showing three rows of semilunar valves. Those of the upper row are the largest, and have their upper margins projecting freely into the area of the vessel; those of the two lower rows have the upper margins attached to strong fleshy columns.

Prepared by Mr. Clift.

937. The ascending aorta of the Reindeer (*Cervus Tarandus*, LINN.). In this preparation the semilunar valves are seen applied against the sides of the artery as during the systole of the ventricle, the origin of the larger of

the two coronary arteries being then partially covered by one of the valves. The bone which is found at the origin of the aorta in Ruminants is here displayed, and its extent indicated by black bristles. Besides the origins of the coronary arteries from the sinuses of Valsalva, that of the arteria innominata is preserved, which is proportionately larger than in the human subject, as it gives off the left carotid in addition to the right carotid and brachial arteries.

2. *Division or Branching of Arteries.*

938. The *arteria innominata* of a Horse (*Equus Caballus*, Linn.), showing the different angles at which the branches are given off. Those at the beginning of the subclavian are sent off, as Mr. Hunter observes, (*On the Blood*, p. 164.,) at very obtuse angles.

939. A transverse section of the aorta of a Horse, showing two arteries of small size given off directly from it. "We find small arteries coming off at once from large ones, instead of being a third, fourth, or fifth, from the large one." *Hunter, On the Blood*, p. 164.

3. *Anastomosing of Arteries.*

940. Portions of the right and left aortæ of the Turtle (*Chelonia Mydas*, Brogn.), showing their junction in the abdomen.

"Anastomosing of vessels is the opening of one vessel into the other; so that if one of them be prevented from carrying its contents, the office can be performed by the other. The most common mode of anastomosing is, when two vessels run into one, or are continued into each other; or one vessel opens into another, from which others arise; but there is a peculiar communication between the two carotids, as well as between them and the vertebral, where a canal of communication passes directly between them; and this mode of communication takes place between the two descending aortæ of some of the amphibia." *Hunter, On the Blood*, p. 165.

4. *Coats of Arteries.*

"The greatest part of the arterial system evidently appears to be composed of two substances, which structure is most remarkable in the middle-sized arteries, where the two substances are more equally divided, and where the size admits of a visible distinction of parts. The best method to see this is to cut the vessels either across or longitudinally, and to look upon the edges that have been cut.

" If the aorta be treated in this way, we shall find that though it appears to be composed of one substance, yet towards the inner surface it is darker in colour, and of a structure which differs, although but in a small degree, from that of the onter surface.

" If we proceed by this mode of investigation, following the course of the circulation, we shall find that the internal and external parts become evidently more distinguishable from each other. The internal part, which is darker but with a degree of transparency, begins almost insensibly in the larger vessels, and increases proportionably in thickness as the arteries divide, and of conrse become smaller; while the external, being of a white colour, is gradually diminishing, but in a greater degree, according to the diminution of size in the artery, and of the increased thickness of the other coat; so that the two do not bear the same proportion to each other in the small arteries as in the larger." *Hunter*, *On the Blood*, p. 118.

941. A section from the anterior part of the descending aorta of a Horse (*Equus Caballus*, Linn.), showing the diminution of the thickness of the parietes of the vessel as it recedes from the heart.

942. Transverse sections of the crural artery of a Horse, showing the difference of colour in the cellular and fibrous coats, and their relative thickness.

943. A longitudinal section of the same artery, showing more distinctly the darker-coloured fibrous coat.

944. A section of an artery of the human subject, in which a portion of the smooth lining membrane is reflected from the lower part, and the middle fibrous coat separated from the outer cellular coat at one of the angles.

945. A portion of the posterior tibial artery of a Dog (*Canis familiaris*, Linn.), in an extremely contracted state. This preparation is alluded to in the following passage from the 'Treatise on the Blood,' &c.

" To prove the muscularity of an artery, it is only necessary to compare its action with that of elastic substances.

"Action in an elastic body can only be produced by a mechanical power; but muscles, acting upon another principle, can act quickly or slowly, much or little, according to the stimulus applied; although all muscles do not act alike in this respect......

"The posterior tibial artery of a Dog being laid bare, and its size attended to, it was observed to be so much contracted in a short time as almost to prevent the blood from passing through it, and when divided, the blood only oozed out from the orifice." *Hunter, On the Blood,* p. 114.

946. A portion of an artery from the uterus of a Cow (*Bos domesticus,* LINN.). The vessel is in a very contracted state, but has been laid open, and its sides kept apart by bristles.

"The arteries upon the whole may be said to possess considerable living powers, and to retain them for a long time...... I found in the uterus of a cow, which had been separated from the animal above twenty-four hours, that after its having been injected and allowed to stand another day, the larger vessels were become much more turgid than when I first injected them, and that the smaller arteries had contracted so as to force the injection back into the larger. This contraction was so obvious that it could not but be observed at the time, which was forty-eight hours after the separation from the body of the animal.

"This shows, too, the muscular power of the smaller arteries to be superior to that of the larger, and that it is probably continued longer after the separation from the body; a property which the involuntary muscles possess to a degree greater than the voluntary, in the former of which classes the muscular structure of the arteries is to be considered."

Hunter, On the Blood, p. 115.

947. Two portions of an umbilical artery; one of them of the natural size, as when distended with blood, the other in a contracted state.

"To ascertain how long the living power existed in an artery after separation from the body, or perhaps, to speak more properly, after that communication with the body was cut off by which we have reason to suppose life to be continued in a part, I made the following experiments, for which I chose the umbilical arteries, because I could confine the blood in them, and keep them distended for any length of time. In a woman delivered on the Thursday afternoon, the navel-string was separated from the fœtus: it was first tied in two places and cut between, so that the blood contained in the chord and placenta was confined in them.

"The placenta came away full of blood; and on Friday morning, the day after, I tied a string round the chord about an inch below the other ligature, that the blood might still be confined in the placenta and remaining chord. Having cut off this piece, the blood immediately gushed out, and by examining the cut ends of the chord, I attentively observed to what degree the ends of the arteries were open, and the blood having now all escaped from this portion, the vessels were left to contract with the whole of their elastic power, the effect of which is immediate.

"Saturday morning, the day after this last part of the experiment, having examined the mouths of the arteries, I found them closed up, so that the muscular coat had contracted in the twenty-four hours to such a degree as to close entirely the area of the artery. That same morning I repeated the experiment of Friday, and on Sunday morning observed the result of this second experiment to be similar to that of the former.

"On this morning, Sunday, I repeated this experiment the third time, and on Monday observed that the result had not been the same as before, the mouths of the arteries remaining open; which showed that the artery was become dead.

"There was but little alteration perceived in the orifices of the veins in all the experiments.

"These experiments show that the vessels of the chord have the power of contraction above two days after separation from the body."

Hunter, On the Blood, p. 115.

948. A section of the aorta ascendens.

949. A longitudinal section of the thoracic aorta.

"Experiments on the power of arteries to contract longitudinally.

"To prove that arteries do not produce the same power of muscular contraction in a longitudinal, which they do in a transverse direction, the following experiments were made:

"Experiment 1st. A longitudinal section of the aorta ascendens, measuring two inches, when stretched and allowed again to contract, measured the same length.

"Experiment 2nd. A longitudinal section of the aorta descendens at the lower part of the thorax, of a given length, after having been stretched, contracted exactly the same length.

"Experiment 3rd. Two inches of the same carotid artery used in the sixth experiment, when stretched longitudinally, recovered itself, so as not to be longer than before the experiment.

"Experiment 4th. A portion of that humeral artery used in the eighth of the former experiments was not altered in its original length when it recovered itself after being stretched.

"These experiments appear to be decisive, and prove that the muscular power acts chiefly in a transverse direction; yet it is to be observed, that the elastic power of arteries is greater in a longitudinal than in a transverse direction. This appears to be intended to counteract the lengthening effect of the heart, as well as that arising from the action of the muscular coat; for the transverse contraction of that coat lengthens the artery, therefore stretches the elastic, which again contracts upon the diastole of the artery." *Hunter, On the Blood*, p. 127.

950. A portion of the carotid artery of a Horse, showing the contraction consequent on a transverse section of the living vessel.

951. A similar specimen laid open to show the thickening of the coats at the contracted end.

952. Two portions of a smaller artery similarly contracted.

953. A portion of the artery of the penis of a Zebra, much contracted.

954. A portion of the artery of the penis of a Horse.

955. A longitudinal section of the same artery.

"The artery of the penis, when stretched longitudinally or transversely, recovered itself perfectly. This artery is considerably more elastic longitudinally than the others, but not more transversely. This increased elasticity in the longitudinal direction may be intended to allow of the difference in the length of the penis at different times.

"From these experiments we see that the power of recovery in a vessel is greater in proportion as it is nearer to the heart; but as it becomes more distant it lessens, which shows the decrease of the elastic and the increase of the muscular power." *Hunter, On the Blood,* p. 127.

956. A portion of an artery of a Turtle (*Chelonia Mydas*, Brogn.), laid open longitudinally to show the contraction and corrugation of the inner coat, consequent on a transverse section of the living vessel.

957. Transverse sections of an artery of a Turtle, one showing the natural size of the area of the vessel as when distended with blood, and the other the complete obliteration of the cavity by the contraction which takes place in the living vessel when the distending force is removed.

958. Transverse sections of an artery of a Turtle in different states of contraction, showing the thickening of the parietes of the vessel and the wrinkling of the internal coat, consequent on the muscular contraction.

"In those arteries which are evidently composed of two distinct substances, especially in the smaller, we may observe two very opposite appearances, according as the elastic or muscular coats have contracted most. In the one, when we make a transverse section and look upon the cut end, we may observe that the inner surface has been thrown into rugæ, so as to fill up the whole cavity; and if such an artery be slit up longitudinally, so as to expose its inner surface, we shall find that inner surface forming wrinkles, which are principally longitudinal. If the finger is passed over that surface, it feels hard, while the external is soft; but if the artery be stretched, and allowed to recover itself by its elasticity, which is the only power it now has, it will be felt equally soft on both surfaces, and its coats will be found to have become thinner than before." *Hunter, On the Blood,* p. 120.

959. A portion of an artery of a Turtle. It is inverted to show the irregularity of the inner surface consequent on the fasciculate disposition of the fibrous or muscular coat.

960. A portion of an artery of the same species, laid open longitudinally, to show

the fasciculate disposition of the internal coat produced in a more marked degree.

961. A transverse section of the same artery in a state of contraction.

962. A portion of an artery of a Turtle, laid open longitudinally.

"As the human body is always alluded to in this account, I shall found my experiments and observations on such animals only as have a similar structure; as in other animals, as the Turtle, Alligator, &c., we can plainly discern muscular fibres, the insides of the arteries and veins being evidently fasciculated with them." *Hunter, On the Blood*, p. 118.

962 A. A transverse section of the inferior vertebral canal, abdominal aorta, and vena cava, of the Basking Shark (*Selache maxima*, Cuv.), showing the simple nature of the coats of these vessels when they are so situated as to be passive conductors of the circulating fluids. This occurs when vessels are protected by and adhere to firm and unyielding textures, as bone or cartilage. *Prepared by Mr. Clift.*

SERIES IV. Structure of Veins.

1. *Coats of Veins.*

963. A longitudinal section of the inferior vena cava of the human subject. The internal coat is not so smooth as in the aorta: the fibrous coat is denser, though much thinner.

"The coats of the veins, upon the whole, are not so thick as those of the arteries; but differ materially in different situations of the body. Thus, they become thinner and thinner, in proportion to their size, the nearer to the heart..... They are similar to the arteries in their structure, being composed of an elastic and muscular substance; the elastic in some degree preserving a middle state, although not so perfectly as in the arteries. The muscular power adapts the veins to the various circumstances which require the area to be within the middle state, and assists the blood in its motion towards the heart." *Hunter, On the Blood*, pp. 180, 181.

964. This preparation is called in the MS. Catalogue 'Vein from the liver of a

Horse, contracted in dying.' It has a reticular inner surface, similar to the inner surface of some of the arteries and veins of the Turtle.

965. A transverse section of the vena cava inferior of a Turtle. It is inverted to show the irregularity of the internal surface.

966. A small portion of the vena cava hepatica of a Turtle.

967. A longitudinal section of the vena hepatica, with a portion of the liver, of a Turtle. The internal surface of the vein is slightly reticulated.

968. A section of the vena portæ from the same liver, showing the orifices of numerous branches.

969. A section of the vena portæ, with part of the liver, of a Turtle, showing the thickness of the coats of the vein, and the reticulate structure of its inner surface.

970. Another section of the same vein.

971. A section of an hepatic vessel, with a portion of the liver, showing the orifices of the branches of a transverse or linear form.

972. A section of a vessel, with a glandular substance attached, showing the orifices of the branches of the same peculiar linear form.

973. A section of apparently the same vessel.

2. *Valves of Veins.*

"Veins have interruptions in their cavities, called valves. They are thin, inelastic membranes, of an exact semilunar form; their unattached edge being cut off straight, not curved, as in those of the arteries; and this is, because there are only two of them, whose semicircumference adheres to the sides of the vein. They are not placed in a transverse direction, so as to cut the axis of the vein perpendicularly; but obliquely, as the valves at the beginning of the arteries, making a pouch, whose mouth is turned towards the heart. They are attached in pairs, the two making two pouches, whose edges come in contact. In the larger veins of many animals, as the jugular veins of a horse, &c., there are often three valves, as at the beginning of the aorta, but not so completely formed.

These valves, as it were, cut the veins into two at this part. These two valves are not always of equal size. At this part there are always two swellings in this form; but I believe more in the adult than in the young subject. They are not formed from a doubling of the internal coat, as has been imagined; for the internal coat is elastic; but the valves are rather of a tendinous nature. From this circumstance, together with their shape, and their mode of attachment to the sides of the vein, they always do their office whenever the vein is full, in the same manner as the valves of the arteries. The valves of the veins are chiefly in the extremities, jugular veins, and the veins on the exterior parts of the head; but never in the veins of the brain, heart, lungs, intestines, liver, spleen, or kidneys.

"Where a smaller vein opens into a larger, there is often a valvular structure at the acute angles; but this is not constant."

Hunter, On the Blood, pp. 181, 182.

974. A section of the jugular vein of a Camel, with a strip of the parietes removed to show the two semilunar valves intersecting the area of the vessel.

975. Another section of the jugular vein laid open of the same animal, with the spaces between the valves and the parietes of the vessel filled with plaster of Paris.

976. A similar section, showing behind the semilunar valves the orifices of tributary veins, some of which are also provided with a simple valvular fold.

977. A section of the same vein laid open, showing the entire valves.

978. A section of the subclavian vein of a Camel, showing the oblique position and unequal size of the semilunar valves.

979. A transverse section of the vein of a Camel suspended, so as to show the complete intersection of the area of the vessel by the falling inwards of the semilunar valves.

980. A similar section of the jugular vein of a Horse, showing the area of the

vessel similarly intersected by three semilunar valves, as at the origin of the aorta or pulmonary artery.

981. A section of the emulgent vein of a Camel, showing the valvular folds at the openings of some smaller veins, which Mr. Hunter alludes to in the Introduction to this Subseries.

SUBDIVISION V.

RESPIRATORY SYSTEM.

"EVERY part of an animal so exposed to the air as for the blood to be affected by it in such manner as to support life, may be called Lungs, or Respiratory Organ; but what is commonly understood as such, is an apparatus formed for that purpose, as a distinct part of the animal. But I conceive it very probable that there are animals so simple in their construction as not to require a peculiar structure for this purpose. I even know there are many so constructed, where an apparatus of this kind could not be applied, such an apparatus not according with the other parts. Yet I do conceive that in such the application of air is as necessary as in those where an apparatus is formed; but where there is a distinct respiratory apparatus, there must be other corresponding apparatuses.

"Where there is such an apparatus, we find it admits of forms fitted for the different modes of respiration; yet all are included in the terms *Branchiæ*, or Gills, and *Pulmones*, or Lungs. But there should be a generic term, admitting of divisions into species, so as to be characteristic of the orders of animals to which they belong.

"Without a collecting and a motion of the nutritive juices, I can conceive there can be no respiratory organ; for I find that the different circulations in the different orders of animals, as far as I know, are so connected with different kinds of lungs, as for either system not to be intelligible alone. For, first, the different circulations cannot be described without including the respiratory apparatus, as this makes a portion of the circulation. Nor will the mere structure of the lungs in different animals explain their full purposes: and as their whole use is upon the blood, and they are thus connected with the circulation, it is impossible to understand the one without the other, and this so much so, as to make it difficult to say which ought to be described first.

"In animals where there is no circulation there can be no lungs, for lungs are an apparatus for the air and blood to meet, and can only accord with motion of blood in vessels. But where there is no circulation, yet we must suppose from analogy that the air affects the juices that are to carry a continuance of life and support to all the parts of the body *.

"As the lungs are to expose the blood to the air, they are so constructed as to answer this purpose exactly with the blood being brought to them, and so disposed in them as to go hand in hand. The lungs in all animals are therefore placed near the heart, because it is the circulation only that they are concerned in.

"The immediate action which puts the lungs into use is called Breathing, and this action is commonly performed by the surrounding parts, being a motion of dilatation, which produces or is called *Inspiration*; and of compression, which produces or is called *Expiration*: these motions of course are alternate †.

"The respiratory organ, which must be considered as an appendage to the heart and vascular system, is so constructed as to allow the blood to be placed in such circumstances with respect to the external air as to give or receive some influence from it.

"In the most simple animals, and such as breathe water, the whole apparatus is to have a considerable quantity of very vascular surface brought in contact with the medium in which the animal lives.

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* "It may be observed that the *fœtus in utero* is a contradiction to this; but we must suppose that the effect of air in the lungs of the mother is conveyed to the fœtus. But the respiration of the fœtus in the viviparous from an egg cannot be so easily accounted for, since there is no communication with either the mother or external air; but the egg in the oviparous would seem to be in the same predicament, yet I know they will not hatch without air. It is probable that all those animals within animals (*Entozoa*) are similar to the viviparous from an egg."

† "Some animals do not sweat by the skin; in all these we find that their breathing becomes much quicker in warm weather or from exercise than what it does in those that sweat freely. They generally breathe with open mouths, viz. dogs, sheep, goats, oxen, fowls, &c. &c. This would hint as much as that the sweat and breath were nearly the same."

" In the air-breathing orders above fish, there is a simple bag, very vascular, for the reception of the air, and this is divided and subdivided as we proceed towards the more perfect animals, till at last the cells are infinitely small.

" The lungs may be considered, respecting their blood-vessels or circulation, as similar to a gland ; for the blood sent to them is not for their own proper use entirely, and indeed only a very small portion of it is for their own use, the larger portion being intended as a secretion from them, as also to receive.

" The lungs may be called the Spring of Life; I conceive them to have two powers, one to receive, the other to give. I should consider them giving to the air what was rendered useless or detrimental as a constituent part of life ; and exchanging it for that which it had lost, the essential part."

Hunterian MS. Catalogue.

Series I. Aeration of the Blood by means of Gills.

Subseries 1. *In Acalephans.*

982. A Medusa injected (*Rhizostoma cœrulea*, Cuv.), with a portion of the disk removed so as to expose the central cavity, or stomach, and the common orifice by which the numerous nutritive canals of the ramified processes pour their contents into that cavity. The vessels which proceed from it to ramify and subdivide so as to form the respiratory network in the margin of the disk, are successfully injected.

983. A portion of the margin of the same specimen. The colour of the vermilion, which some chemical change has destroyed in the preceding preparation, is here preserved. The vascular network is seen to be formed by the lateral ramifications of straight vessels diverging to the circumference of the disk and placed about an inch apart from each other. The vessels at the central margin of the network are the largest, and encroach in a semicircular form upon the intervals of the straight vessels, before these begin to distribute their lateral branches. The peripheral or terminal vessel of the network is very minute, and follows the scolloped contour of the margin of the disk. The whole of this vascular network is placed on that surface of the disk, which, in the natural position of the living ani-

mal, rests upon the water; and thus this simple but beautiful respiratory apparatus is most effectually brought in contact with that element through the medium of which the circulating fluids of the Medusa are submitted to the influence of the atmosphere.

2. *In Echinodermatans.*

984. A Holothuria (*Hol. tremula*, Linn.) laid open, and the alimentary canal and generative tubes turned aside to show the respiratory organs, which have been injected. These organs consist of two elongated, hollow, ramified processes, commencing by a common orifice from the cloacal cavity and extending towards the opposite end of the body. One of them is in more immediate connexion with the alimentary canal, and is abundantly supplied by ramifications of the intestinal vessel, the contents of which are thus brought into the necessary communication with the sea-water introduced into the tubular branchia from the cloaca. The other gill is more closely attached to the parietes of the body, and probably serves to aerate the vessels of that part.

In the description of the Holothuria, vol. i. p. 252, Mr. Hunter attributes to these organs a more limited share in the great excretory functions than they undoubtedly perform, regarding them, from their connexion with the cloaca, as analogous to the kidneys of the higher animals. Distinct urinary organs, however, are not developed until we arrive at a much higher point in the scale of organization than the Holothuria and its congeners attain to; and the preparation under consideration is therefore placed in its present position in the respiratory series.

3. *In Annellidans.*

984 A. The dorsal and lateral parietes of the body of a Sea-mouse (*Aphrodita aculeata*, Linn.). A bristle is inserted at the interior transverse orifice of the felted tunic, by which the sea-water is freely admitted into the interspace between this membrane and the squamous covering of the back. As the felted tunic terminates at the sides of the body, and adheres there only to the tubular processes of integument which inclose the packets of

bristles, the sea-water can also penetrate to the interior of the body in the intervals of these processes. The internal tunic of the dorsal region has been cut through and turned aside to show the large scales which are situated between it and the felted membrane.

Prepared by Mr. Owen.

985. The dorsal and lateral parietes of a Sea-mouse, with one half of the felted membrane and the squamous processes of the second tunic of the same side removed, to show the sacculi of the internal coat which contained the branched intestinal cæcums and their numerous surrounding capillaries.

986. The internal tunic of the body of a Sea-mouse, containing the alimentary canal and intestinal cæcums, but prepared with a view to show the orifices in the intervals of the stems of the packets of bristles, by which the sea-water, after having passed into the interspace between the felted and squamous tunics, penetrates into the interior of the body and bathes the capillaries of the cæcal processes.

987. A Sea-mouse, prepared to show the branchial sacculi of the internal coat distended, with the intestinal cæcums and capillary vessels. Three distinct and important functions appear to be performed by these parts. The arteries distributed over the coats of the cæcal processes prepare, according to Mr. Hunter's opinion, a substance analogous to bile*, by which the digestive process is completed; and from the freedom with which the contents of the straight intestine penetrate these cæcums, it is reasonable to infer that the chyle is formed in and absorbed from them: lastly, the nutritious fluid, being subjected to the influence of the sea-water while passing along the minute capillaries to the veins, is thus purified and fitted for the general circulation *in transitu*.

In this preparation the small branchial crests projecting from the exterior surface of the sacculi are indicated by the black bristles placed beneath them. The ventral parietes have been also removed to show the alimentary canal; and a piece taken out of the side of the body.

988. The portion of the body removed from the preceding specimen. It shows

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* This opinion is confirmed by Pallas, who observes of these processes, '*chymo impalpabili, olivaceo-fusco, vel viridi-atro, liquido, subamaro repleta plerumque reperiuntur.*'—Miscell. Zool., p. 87.

five of the lateral sacculi and their contents; the curved disposition of the intestinal cæcums conformed to the sacculi; and the smaller processes of the cæcums coming off from the convexity of the curve. The felted membrane is reflected from the squamæ, which adhere to the alternate sacculi of the internal tunic.

989. A portion of the left parietes of the body, with the dorsal and ventral packets of setæ, of an Amphinome (*Amphinome capillata*, Bruguières). This is prepared to show the orifices below the ventral packets, by which the water may have access to the internal branchial plexuses shown in No. 875, of which this preparation is a part: bristles are passed through these orifices.

990. A fine specimen of Tube-worm (*Subella*,—an *villosa*? Cuv.), showing the elongated spiral branchial filaments disposed in a circle around the mouth. These filaments are finely fringed along their inner sides. A longitudinal strip of the parietes of the body is removed, showing the convoluted alimentary canal continued to the opposite extremity.

4. *In Crustaceans.*

991. The right side of the thorax of a Lobster (*Astacus marinus*, Fabr.), prepared to show the branchiæ *in situ*. These are of a filamentary structure, as in the Tube-worms, but are more complicated in structure, and differently disposed. In each gill the branchial filaments project at right angles from a lateral supporting stem, so as to form an elongated pyramidal body attached at the base to the origin of one of the thoracic feet or maxillary feet, and with the apex directed towards the dorsal heart. The first or most anterior gill is a very small one, attached to the base of the third maxillary foot. Four larger gills correspond to the base of the fourth or exterior maxillary foot; and similar groups of four gills are severally attached to the base of the first, second, third, and fourth pairs of thoracic feet. A single gill only corresponds to the fifth pair, and terminates the series as it commenced.

Each gill or group of gills is separated from the next by a strong membrane, supported by a process continued backwards from the base of the feet, and armed with small spines directed backwards: similar laminæ are extended from those maxillary feet to which no branchiæ are attached. These laminæ act upon the branchiæ in the several movements of the feet, so as, by alternately compressing and expanding the interspaces, to occasion the necessary renewal of the water, which has free access to, and outlet from, the branchial chambers. Thus the activity of the respiratory function is increased according to the exercise of the locomotive powers, and the circulation simultaneously accelerated.

992. A single branchia of a Lobster, in which the longitudinal trunk which transmits the branches to the several filaments is injected.

993. A Craw-fish (*Astacus fluviatilis*, Fabr.), with the left side of the thorax and left legs removed to show the branchiæ *in situ.*

The branchial filaments in this species are proportionately fewer, larger, and more obliquely disposed: those of the middle gills in each group have their extremities attached to a marginal vessel.

993 a. A large male Craw-fish, with the branchiæ of both sides exposed and injected. *Presented by Sir Christopher Pegge.*

993 b. A Prawn (*Palæmon serratus*, Leach), with the branchiæ similarly exposed and injected. *Presented by Sir Christopher Pegge.*

993 c. Several of the branchiæ of the Robber-crab (*Birgus Latro*, Leach). These are of an elongated subcylindrical form, pointed at both extremities, and attached at the middle to the base of the feet. They are composed of a double series of semicircular laminæ placed perpendicularly to the supporting stem, and in which the blood is submitted, by the subdivision of the branchial vessels, to the influence of the surrounding medium. *Prepared by Mr. Owen.*

993 d. A Hermit-crab (*Pagurus Streblonyx*, Leach), with the branchiæ injected and exposed on both sides. *Presented by Sir Christopher Pegge.*

993 e. A small Crab (*Cancer Pagurus*, Leach), with the carapace and all the viscera removed, except the branchiæ. These are crossed, and, as it were, bound together by a narrow flattened process, which extends from the anterior part of the branchial cavity.

Presented by Sir Christopher Pegge.

993 F. Another species of Crab (*Carcinus Mænas*, Leach), similarly prepared to show the branchiæ *in situ* injected.

Presented by Sir Christopher Pegge.

In the Crabs, or brachyourous Crustaceans, the branchiæ are elongated pyramidal bodies, as in the Lobster; but they are of a laminated, not filamentous, texture, the vascular laminæ being closely arranged at right angles to a lateral stem.

5. *In Cirripeds.*

994. A pedunculated Barnacle (*Pentelasmis vitrea*, Leach), with the valves and corresponding part of the mantle removed from one side to show the branchiæ. These are elongated pyramidal bodies, adhering by one extremity to the base of the articulated feet, as in the Lobster. Four of these branchiæ are seen in this preparation, three being attached to the base of the first foot or cirrus, and the fourth to that of the second.—(See vol. i. Pl. IV. fig. 3. taken from this preparation.)

995. The soft parts of a Tube-Barnacle (*Tubicinella Balænarum*, Lam.), with a portion of the mantle removed from either side to show the branchiæ. These are not attached to the base of the feet, as in the Pentelasmis, but adhere to the inside of the mantle, as in most bivalve mollusks. They are of a membranous structure, and composed of numerous minute transverse plicæ. Two of the side-valves are removed to show the cirri retracted: these valves are here so small as to protect only those parts, the branchiæ and other viscera being lodged in the peduncle, and defended by a calcification of the exterior layer of that tube, to which, therefore, the small valves are now subservient as an operculum. The calcareous tubes or peduncles of this parasitic species are usually found imbedded in the skin of the Whale.

996. The soft parts and side-valves or operculum of a sessile Barnacle (*Balanus rugosus*, Lam.). At the base of the specimen are seen the two large lateral branchiæ, with the convoluted genital tube in the middle. The branchial laminæ here extend from either side of a central vessel, and give a foliated appearance to the gill.

997. A Crown-Barnacle (*Coronula Diadema*, LAM.), with numerous Eared-Barnacles (*Otion Cuvieri*, LEACH) adhering to its shell, part of which is removed, together with the mantle, to show the branchiæ. These have the same membranous and foliated structure as in the preceding specimen, but are more numerous.

The skin of the Whale to which this specimen was attached has undergone the same change as in the preparation No. 613 (vol. i. p. 193.).

6. *In Mollusks.*

998. A small Ascidian (*Cynthia papillosa*, SAVIGNY), from which a longitudinal section of the outer coriaceous covering and mantle has been removed to expose the branchial cavity. This has been laid open to show its longitudinally plicated structure, and the tentacles which guard the branchial orifice. The mouth is situated at the bottom of the respiratory cavity, and the intestine terminates below the second or anal orifice, into which a black bristle is inserted.

998 A. One of the mantle-lobes of a Terebratula (*Ter. Sowerbii*, KING), and the soft parts of a small *Terebratula Chilensis*, BRODERIP; showing the large vessels which ramify upon the mantle in order to expose the blood to the influence of the surrounding medium for respiration. These vessels form a delicate network around the margin of the mantle, which is provided with minute but complex cilia to excite the necessary currents. In the upper specimen from the *Ter. Sowerbii* the branchial vessels are obscured by ova, which insinuate themselves between the layers of the mantle-lobe prior to being discharged, as in the gills of some of the higher bivalves. In the *Ter. Chilensis* the vessels are not so obscured, and in this specimen the peduncle, decussating muscles, liver, and ciliated arms are preserved. *Prepared by Mr. Owen.*

998 B. The lobes of the mantle of an Orbicula (*Orb. lamellosa*, BRODERIP), showing the vascular network formed by the branchial vessels and the marginal respiratory cilia. This form of aquatic respiratory organ is almost as simple as in the Medusa, and it presents a beautiful analogy with the air-breathing sacs of the Snail tribe. *Prepared by Mr. Owen.*

998 c. The soft parts of a Lingula (*Ling. Audebardii*, Brod.). In this genus the branchial vessels give off on each side of the mantle-lobe parallel oblique series of small vascular loops, protected by corresponding folds of the pallial membrane, and presenting the first stage in the formation of the lamellated gill which is superadded to the mantle in the higher bivalves. *Prepared by Mr. Owen.*

999. The soft parts of a Scallop (*Pecten maximus*, Linn.) injected. The right mantle-lobe is reflected to expose the branchiæ, which are seen protected by the mantle on the opposite side. The branchial membrane is very delicate in this species, and is supported by numerous close-set horny filaments, along which the branchial vessels pass. The branchiæ are placed near the circumference of the shell, and currents of sea-water are perpetually driven over and through them by the action of the shell and mantle. The large foot of this species is placed between the branchiæ, which are four in number, two on either side. A thick bristle is inserted at the mouth, and a smaller one at the opposite orifice of the digestive canal.

1000. A similar specimen, injected, and with the right mantle-lobe wholly removed, to show the branchiæ of that side and their supporting membrane. This is broadest at the posterior end of the branchiæ, and terminates in a point anteriorly, where the branchiæ are lost between the two labial membranes.

1001. A pearl Oyster (*Meleagrina margaritifera*, Lam.), from which the left valve and corresponding mantle-lobe have been removed to show the branchiæ. The membrane covering the branchial vessels and filaments is here better displayed than in the *Pecten*. The orifices at the concave edge of the branchiæ, by which the water is driven through their interspaces, are well displayed in this specimen, which also shows the foot and horny filaments composing the byssus.

1002. The soft parts of a freshwater Muscle (*Anodon cygneus*, Sowerby), injected and prepared to show the four branchiæ, which unite below the foot. The convolutions of intestine at the base of the foot and the passage of the rectum through the heart are also shown in this specimen.

1003. The soft parts of a freshwater Muscle, with both mantle-lobes and heart dissected away, so as to clearly display the branchiæ and labial processes. The orifices of the branchial vessels and water-tubes are well displayed at the base of the branchiæ. The first series of vessels, which run transversely across the branchiæ, give off lateral ramulets at right angles, and form a most delicate vascular network to receive the influence of the respiratory currents.

1004. A transverse section of the branchiæ of a freshwater Muscle, injected, dried, and preserved in oil of turpentine. It affords a beautiful display of the vascularity and delicate structure of the respiratory organ.

1005. The right branchiæ and labial processes of a Solen (*Solen siliqua*, Linn.). These have a delicate reticulate structure like those of the freshwater Muscle.

1006. The soft parts of a large Chiton (*Chiton squamosus*, Linn.), prepared to show the branchiæ. These consist of small triangular laminæ, arranged in a single series along the outer side of the depression between the foot and the projecting margin of the mantle. Each branchial lamina is finely striated in the transverse direction at the sides, and has a vessel running along each margin; the exterior being the branchial vein, the interior the branchial artery. From the external position of the branchiæ the blood is at once exposed in the minute transverse branches to the influence of the water.

1007. A Limpet (*Patella deaurata*, Gmel.), in which the branchiæ are external, and lodged, as in the Chiton, between the foot and mantle, but form in this species a complete circle. The branchial laminæ have a similar structure to the preceding, but are more numerous, and of a proportionately smaller size.

1008. The soft parts of a large *Fissurella*. The mantle has been dissected away from a part of the back to expose the branchiæ, which are two in number, of an elongated pyramidal form and transversely laminated structure, placed symmetrically one on either side the central orifice of the branchial cavity, with their apices directed forwards.

1009. The soft parts of a small Halyotis (*Hal. tuberculata*, Linn.). The branchial cavity, which is on the left side of the foot, is laid open to show the two elongated pyramidal pectinated branchiæ, placed on either side the rectum.

1010. A Doris (*Doris tuberculata*, Lam.), showing the branchial cavity opening on the dorsal aspect and near the posterior extremity of the body. The arborescent branchiæ are retracted within this cavity: they are placed around the anus. Bristles are introduced at the mouth, and outlet of the generative apparatus.

1011. A small Aplysia (*Aplysia alba*, Cuv.), with a portion of the mantle dissected away to expose the branchiæ. These are also of an arborescent structure, but are more complex and better defended than in the Doris, the respiratory cavity being shielded by a thin horny plate or rudimentary shell.

1012. A larger specimen of the same species of *Aplysia*, further dissected, so as to show, in addition to the branchiæ, the heart and pericardium, the mouth and masticatory organs, the stomach, nervous ganglia, and the penis on the right side of the neck. A portion of the shell is left to show how loosely it is lodged between the layers of membrane forming the roof of the branchial chamber.

1013. Another species of Aplysia (*Apl. Camelus*, Cuv.), in which the branchiæ are shown in their natural position, without any dissection, by merely separating the dorsal lobes of the mantle, and elevating the roof of the branchial chamber.

1013 a. Portions of two species of *Calyptræa*, prepared to show the single pectinated branchia in each. The branchial cavity commences by a wide aperture above and on the left side of the head, and extends along the circumference of the body to a greater or less distance. In the lower specimen (*Calyptræa Adolphei*, Lesson) it ends at the posterior part of the body, while in the upper one (*Cal. radiata*, Broderip) it reaches to the middle of the right side of the foot. The internal calcareous plate, which in this genus separates the viscera from the foot, always corresponds to the extent of the branchia and to the development of the foot.

Prepared by Mr. Owen.

1014. A Purple (*Purpura patula*, Lam.), with part of the shell and mantle removed to show the two pectinated branchiæ, and the mucous gland which secretes the coloured substance from which this gasteropod derives its name. It is conjectured to have been the species from which the Romans obtained their purple dye.

1015. The soft parts of a Whelk (*Buccinum undatum*, Linn.), with the respiratory cavity laid open to show the two pectinated branchiæ, of unequal size, adhering to its inner surface.

1016. One of the branchiæ, injected, of a Cuttle-fish (*Sepia officinalis*, Linn.). It is composed of two lateral series of transverse laminæ, extending from one margin, which contains the branchial artery, to the opposite margin, along which the branchial vein passes. Each lamina is composed of smaller transverse laminæ, and these are again transversely plicated, giving a tripinnatifid structure to the whole gill. The larger or primary laminæ are each suspended by a thin membrane, which is broadest at the arterial margin; and this is the thickest and most muscular, and forms the stem of the branchia, by which it is attached to the inside of the fleshy mantle.

1017. The opposite branchia of the same Cuttle-fish, in which the colour of the fine injection is better preserved, and the vascularity of the gill more beautifully displayed.

Besides the great extent of surface which is exposed by the complex structure here displayed to the currents of sea-water which incessantly traverse the branchial cavity, the respiratory function in this and other dibranchiate Cephalopods is further perfected by the superaddition of a ventricle for the express purpose of propelling the venous blood through the gill. (See Nos. 901, 902.)

7. *In Fishes.*

a. Where the respiratory Currents pass both in and out of the external branchial Apertures.

1018. A section of the anterior part of the South Sea Myxine (*Heptatrema cirratum*, Dumeril.), showing the gills *in situ*, seven on either side, and the corresponding external and internal apertures which lead to them, and in which bristles are inserted.

The gills are circular flattened sacs, and are connected by short canals leading from opposite sides to the parietes of the body in one direction, and to the pharynx in the other, the terminations of the canals forming the apertures above mentioned. The three anterior branchiæ of the left side are removed.

The heart is preserved, and the branchial artery is seen to divide at once into two branches, corresponding to the separate branchial arteries of the Cephalopods, each branch diverging and supplying the gills of its respective side.

1019. One of the branchiæ removed from the preceding specimen, to show its form and the canals by which the respiratory currents are conducted to its interior.

1020. Another branchia of the same, unopened, with a small section removed from the margin to show the close-set laminæ.

1021. A longitudinal section of another of the branchiæ of the same specimen, showing the respiratory laminæ converging from the circumference to the centre where the aperture of the oblique passage leading to the gill is situated, and through which a bristle is placed.

1022. A section of the anterior part of a Lampern (*Petromyzon marinus*, LINN.), minutely injected, in which the seven branchiæ of the left side, and their corresponding external and pharyngeal apertures, together with the heart and branchial artery, are well displayed. The mesial conjugation of the vascular system of the branchiæ has here advanced further than in the Myxine, the artery continuing single until it reaches the interval of the third and fourth gill, where it divides into two branches, which supply the three anterior pairs of respiratory sacs. Of these, the sixth is laid open, showing the component vascular laminæ, which converge, as in the Myxine, but in a less degree, towards the two apertures, which are here situated on the margins of the sac.

1023. The opposite side of the same Lampern, with the branchiæ *in situ*, except the seventh and one half of the sixth, which have been removed. Bristles are passed through the apertures of the branchial sacs, and the corresponding ones of the pharynx and integument.

1024. A portion of the moiety of the sixth branchial sac removed from the preceding preparation, showing the structure of the respiratory laminæ, which are made up of smaller transverse plicæ, upon which the branchial arteries minutely subdivide, a great extent of a vascular surperficies being thus exposed to the respiratory currents.

1025. The other part of the same gill, in which the component laminæ are separated by the stretching of the sac upon a convex surface, and their delicate and complex structure more clearly displayed.

1026. The seventh branchia of the same fish, laid open to show the two series of vascular laminæ projecting from opposite sides of the sac, twenty-six on each side.

1027. A small portion of a Lamprey (*Petromyzon fluviatilis*, Linn.), with four of the branchial sacs of the right side *in situ*, and their corresponding external apertures.

1028. A similar specimen from the opposite side of the body.

1029. The anterior part of a Lamprey, showing the seven branchial apertures of both sides, and the corresponding gills of the left side partially exposed. When the Lamprey is firmly attached, as is commonly the case, to foreign bodies by means of its suctorial mouth, it is obvious that no water can pass by that aperture from the pharynx to the gills; it is therefore alternately received and expelled by the external apertures. If a Lamprey, while so attached to the side of a vessel, be held with one series of apertures out of the water, the respiratory currents are seen to enter by the submerged orifices, and, after traversing the corresponding sacs and the pharynx, to pass through the opposite branchiæ and to be forcibly ejected therefrom by the exposed orifices. The same mode of respiration must take place in the Myxine while its head is buried in the flesh of its prey. The Cyclostomous fishes thus present an obvious affinity to the

Cephalopods, in as much as the branchial currents are independent of the actions of the parts concerned in deglutition.

1030. The head of a Lamprey, dissected, to show the communication of the small aperture on its upper part with the pharynx.

b. *Where the respiratory Currents enter by the Mouth, and are expelled by one Orifice on each side.*

1031. The four branchiæ of the right side of a Cod-fish (*Gadus Morrhua*, Linn.). Each of these organs is of a crescented form, and is composed of a double series of elongated cartilaginous laminæ supporting the vascular membrane in which the respiratory change of the blood is effected as it passes in a state of minute subdivision through the branchial vessels. The cartilaginous laminæ are attached to the four branchial arches of the hyoid bone, from which arches they radiate in a direction outwards and backwards. From the concavity of the first branchial arch a series of strong unvascular laminæ extends inwards, so as to form a defence to the gills against the substances taken into the mouth for nourishment.

1032. A transverse section of the first gill of a Cod-fish, showing the extent to which the two series of branchial laminæ are united, and their structure. The branchial artery runs along the convexity of the supporting arch in the interval of the base of the branchial laminæ; the transverse section of its area is therefore here seen. It gives off two branches opposite each pair of the laminæ, which pass outwards to the end of the uniting substance, and then severally subdivide, one of the ramuli extending along the internal margin of the branchial laminæ to its extremity, the other retrograding to its base. From these ramuli the minute transverse vessels are given off, which distribute the blood over the papillose surface of the laminæ, and ultimately form the branchial veins from which the systemic artery is continued. The parts being minutely injected well display the vascularity of the respiratory membrane.

1033. A portion of the same gill, with the free extremities of one series of the branchial laminæ cut off.

1033 a. The branchiæ of both sides of a Mackerel (*Scomber Scombrus*, Linn.)

minutely injected, showing how they are suspended from the branchial arches, and how these are prevented from coming into too close contact by the tubercular projections at the sides of their concave margins: the defensive unvascular laminæ which project from the concavity of the first arch are also seen. The number of branchiæ in this, as in all osseous fishes, is eight, which are disposed in pairs and gradually diminish in size from before backwards. *Presented by Joshua Brookes, Esq.*

1034. The anterior part of the body of a Mullet (*Mugil Chelo*, Cuv.). The operculum, or gill-cover, of the right side is removed, and the branchiæ dissected away to show the delicate fringes attached to the concavity of each branchial arch, for the purpose of preventing the passage of food or other substances between the branchial interspaces. The delicacy of this protecting apparatus has an evident relation to the nature of the food and the minute division which it undergoes before deglutition.

1035. A longitudinal section of the anterior part of the body of a Conger Eel (*Conger vulgaris*, Cuv.), showing the branchial cavity and gills, which are minutely injected. The water, which is admitted by the mouth, passes by five oblique apertures into the branchial cavity, and is forcibly driven by the simultaneous action of the branchial arches and operculum through the interspaces of the gills, and escapes by a single outlet, as in all osseous fishes. This outlet in the Conger and other Eels is a small vertical fissure, situated at some distance behind the gills; the branchial cavity is therefore proportionately elongated, and the escape of fluid from it is consequently impeded. As the branchial laminæ are thus kept apart and supported by the contained fluid, which insinuates itself everywhere between them, the circulation goes on in them uninterruptedly when the fish is out of the water; and as fresh air is probably absorbed from the surrounding atmosphere as that which was originally mixed with the water becomes deteriorated by the respiratory process, the fish is enabled by this modification of the branchial apparatus to remain out of its natural element for a considerable length of time.

1036. A portion of a smaller Conger, with the branchial cavity exposed on one side, and left entire on the opposite. The branchiæ have the same structure as in other osseous fishes, but the arches of support are destitute of those defensive fringes which are generally present on their concave margins in the rest of the class.

1037. Three branchiæ of the Conger, minutely injected, showing the double series of their component vascular laminæ, and the unarmed concave surfaces of the cartilaginous arches.

1038. A portion of the remaining branchia of the same fish. The cut extremities show the extent to which the two series of branchial laminæ are united, and the delicate transverse laminæ of the second order on which the branchial vessels ultimately subdivide.

1039. A longitudinal section of the anterior part of the body of a Pipe-fish (*Syngnathus rubescens*, Risso), showing on one side the five apertures leading from the pharynx to the branchial cavity, and on the other side the single small outlet.

1040. The anterior part of the same species of Syngnathus, with the operculum removed on both sides to show the branchiæ, the component laminæ of which are collected into tufts, arranged in a double series along the convexity of each branchial arch.

1041. The anterior part of the body of another species of Pipe-fish (*Syngnathus æquoreus*, Linn.), with the opercular covering of the right side removed to show the branchiæ, similarly composed of a double series of tufts on each of the four arches, but with the tufts smaller and more numerous.

1042. One of the gills of a Sturgeon (*Acipenser Sturio*, Linn.). It is essentially of the same structure as in the ordinary osseous fishes, but differs in some respects as to form. The curve of the branchial arch is more considerable, and the pairs of laminæ are united for a greater extent.

1043. Six pairs of branchial laminæ of the gill of a Sturgeon. The vascular respiratory membrane has been removed to show the delicate branched processes of the cartilaginous stem by which it is sustained.

1044. A single pair of the branchial laminæ from the same gill, showing the extent to which they are united, the thickness of the cartilaginous arch on which they are supported, and the delicate processes which extend from their outer margins.

c. *Where the respiratory Currents enter by the Mouth, and are expelled by five Orifices on each side.*

1045. A portion of one of the gills of the *Cephaloptera Manta*, Bancroft. The cartilaginous component laminæ of this singular gill are apparently attached by only one extremity, viz. to the branchial arch. Their free margins are convex, and support an imbricated series of small semicircular bars transversely disposed, the convex edges of which are armed with minute teeth, or spines.

1046. A section of a Cramp-fish, or Torpedo, (*Raia Torpedo*, Linn.,) showing the internal and external branchial orifices of the left side. The branchiæ are five in number, and are supported by as many branchial arches of the os hyoides; but instead of being suspended freely in the branchial chamber, their convex margins adhere to the integument, which extends over the branchial interspaces, so as to leave only very small outlets for the respiratory currents: bristles are passed through these orifices.

1047. A portion of the first or anterior branchia of a Torpedo. This differs from the remaining four in having the component vascular laminæ confined to the posterior surface of the supporting membrane; the cartilaginous rays upon which this membrane is spread, and the branchial vein, are alone seen on the opposite side.

1048. A portion of the first and second branchiæ of the same fish, showing the perpendicular vascular laminæ projecting, in the latter, from both sides of the apparatus of support, which consists, as in the first gill, of membranes spread upon diverging cartilaginous rays. From the continuation of the anterior layer of the supporting membrane of the second gill with that of the first, a cavity is formed, which includes the opposite laminæ of the two gills, and is a close approximation to the completely separated branchial sac of the Lamprey (No. 1026).

1049. The corresponding parts of the same branchiæ, with their connecting membrane divided, and the sac, which it forms, thus laid open to show the opposite series of component vascular laminæ.

1050. The third branchia of a Torpedo, showing the strong cartilaginous arch at the basis, the supporting membrane, and the series of transverse, vascular, plicated laminæ on both sides of the membrane.

1051. The fourth branchia of the same, in which some of the cartilaginous rays which support and move the branchial membrane are exposed. The concavity of the branchial arch may be observed both in this and the preceding specimens from the Torpedo to be unprovided with the laminæ, teeth, or asperities which serve to defend the entrance of the branchial chamber in most of the preceding examples of the respiratory organs of fish.

1052. A small portion of the fifth branchia of the same Torpedo, showing the structure of the component laminæ, each of which is made up of close-set transverse folds, sustaining the minute ramifications of the branchial vessels, and presenting in the aggregate a surface of vast extent to the respiratory currents.

1053. A similar section from the middle of the branchia.

1054. A pair of the component vascular laminæ, separated, showing their marginal vessels, and the transverse folds on which these ramify and subdivide.

1055. A single lamina of the same gill.

1056. A similar preparation.

1057. A section of one of the component laminæ of the same gill, in which the secondary laminæ may be observed by a lens to be again transversely plicated as in the gill of the Cuttle-fish.

1058. A similar preparation.

All the preceding specimens from the Torpedo have been minutely and brilliantly injected. The branchial vessel, which stands in the relation of a trunk to each decreasing series of laminæ, always runs along the margin, and gives off its branches at right angles.

1058 A. A section of one of the gills of the Basking Shark (*Selache maxima*, Cuv.), showing on a large scale the structure of the component vascular laminæ, and the muscularity of the septum, to the sides of which they are attached. *Prepared by Mr. Clift.*

1059. A vertical section of the anterior part of the gray Shark (*Galeus communis*, Cuv.), showing the five large orifices of the pharynx leading to the separate branchial passages, and the corresponding small vertical outlets on the external surface. The branchial arches are here seen to be provided with pyramidal processes, which defend in some degree the entrance to the respiratory cavities. At the anterior part of the post-orbital aperture a few small vascular laminæ may be observed, like a rudimentary gill.

The form and disposition of the teeth; the œsophageal processes, and the cranial and vertebral cavities are also well displayed in this specimen.

1060. A section from the opposite side of the same specimen, showing the relative thickness of the branchial arches, and the disposition and relative extent of the component laminæ of each gill.

1061. A fœtus of the blue Shark (*Carcharias glaucus*, Cuv.), showing the temporary external branchiæ peculiar to that state. These consist of numerous elongated filaments, which project from the branchial apertures immediately anterior to the pectoral fins. Each filament contains a single minute reflected vessel, in which the blood is thus submitted to the action of the surrounding medium. The pedicle of the yolk-bag is seen attached to the abdomen.

SERIES II. Aeration of the Blood by means of both Gills and Lungs.

SUBSERIES 1. *Throughout Life, as in the 'Perennibranchiate Amphibians.'*

1062. A Siren (*Siren lacertina*, LINN.), with the ventral parietes of the abdomen removed, together with all the viscera except the lungs, which have been distended with spirit. These commence immediately below the pericardium and extend almost to the anus. A bristle is passed through the trachea, and the laryngeal orifice is exposed by the removal of part of the cranium. The branchiæ are external, three on each side, and suspended to four cartilaginous arches of the hyoid bone. The three internal branchial apertures of the left side may be seen.

1063. The right side of the head of a larger specimen of the *Siren lacertina*, showing the branchial arches and gills of that side. The first and fourth branchial arches are fixed, the intermediate ones only being free. Their concave margins are provided, as in many fishes, with small pointed processes, which lock into one another and defend the branchial passages. The gills increase in size from the first to the third, which is suspended to both the third and fourth arches. They are subdivided and fimbriated inferiorly, where the surface is most vascular: the branchial arteries may be seen injected on the convex side of the cartilaginous arches. The origin and subsequent reunion of the branchial vessels to form the aorta are shown in the specimen No. 914, from which this preparation has been taken.

1064. A portion of one of the lungs of the same Siren, laid open to show the ramifications of the pulmonary artery, which form a vascular network upon the internal surface of this simple respiratory bag. The following is Mr. Hunter's description of the twofold respiratory apparatus of the Siren. "On the posterior and lateral parts of the mouth are three openings on each side; these are similar to the slits of the gills in fish, but the partitions do not resemble gills on their outer edges, for they have not the comb-like structure. Above and close to the extremity of each of these openings externally so many processes arise, the anterior the smallest, the posterior the largest; their anterior and inferior edges, and extremity are serrated, or formed into fimbriæ: these processes fold down and cover the slits externally, and would seem to answer the purposes of the comb-like part of the gill in fish.

"At the root of the tongue, nearly as far back as these openings reach, the trachea begins much in the same manner as in birds. It passes backwards above the heart, and there divides into two branches, one going to each lobe of the lungs. The lungs are two long bags, one on each side, which begin just behind the heart, and pass back through the whole length of the abdomen, nearly as far as the anus. They are largest in the middle, and honey-combed on the internal surface through their whole length." *Phil. Trans.* lvi. p. 307. (1766.)

2. *For a limited period of Life, as in the 'Caducibranchiate Amphibians.'*

1065. The larva of a Newt (*Triton palustris*, Linn.), with a portion of the head removed to show the internal branchial aperture of the right side, through which a bristle is passed. Externally the branchiæ are shown, which are three in number, progressively increasing in size, as in the Siren, but more minutely and deeply divided or fringed inferiorly, for the subdivision of the branchial vessels.

1066. The left side of the head, with the corresponding branchiæ, and anterior extremity of the same specimen. A bristle is inserted into the lung.

1067. The larva of the *Rana paradoxa*, Linn., with the cavity of the mouth laid open to show the branchial and laryngeal orifices, and the abdomen exposed to show the rudimentary lungs *in situ*, in which bristles have been placed.

1068. The head of a larva of the same species, prepared to show, on one side, the branchial and laryngeal apertures, and on the opposite side, the three series of tufted branchiæ projecting from the membranous arches, and exposed by the reflection of the opercular fold of membrane.

1069. The lungs of the larva of the *Rana paradoxa*. A bristle is passed from the laryngeal aperture directly into the right lung, there being no intervening trachea.

SERIES III. Aeration of the Blood by means of Tracheæ.

" *Of the Respiratory Organs of the Flying Insect.*

"The organs of respiration of the flying insect answer two purposes; —one, the purifying of the blood,—the other for flying.

"It is probable that they are much too extensive for the first use, for in the Beetle they are much larger than in the Fly, because it is much heavier in the body, and therefore requires more of those organs to give it levity." *Hunterian MS. Observations on Insects.*

1070. The crust or integument of a Silk-worm (Larva of *Bombyx Mori*, FABR.) divided longitudinally along the back, and spread out principally to show the spiracles and the first series of radiating branches of the air-tubes. The number of spiracles is eighteen, as in other Lepidoptera and in most Coleopterous insects. The spiracles are connected by a longitudinal air-vessel, from which the secondary tubes or bronchiæ originate from points opposite the spiracles. The bronchiæ are best seen by looking sideways at the preparation.

1071. A similar preparation from a Silk-worm, which is stated in the MS. Catalogue to have been "well fed."

1072. A similar preparation from a Silk-worm of smaller size, stated in the MS. Catalogue to be "of stinted growth from being half-starved." In both these specimens the bronchiæ have been dissected out more minutely than in No. 1070.

1073. The trachea or longitudinal connecting air-vessel of a lateral series of spiracles, with the radiating branches of the bronchiæ, dissected out and removed from the body of a Silk-worm.

1074. A similar preparation.

The following is Mr. Hunter's description of the respiratory organs of the Silk-worm. "From the dark spots on the skin, or openings of the air-ducts, we find a number of dark canals leading inwards, which, as they pass, ramify on the whole internal parts like arteries. All these openings communicate with one another by a dark canal passing from one to another immediately on the inner surface of the skin." *Hunterian MSS.*

1075. A larva of a Sphinx, with the ventral parietes of the body removed to show the wide digestive canal surrounded by the minute ramifications of the air-tubes: the spiracles are preserved on the right side.

1076. An immature specimen of the Mole-cricket (*Gryllotalpa vulgaris*, LATR.), with the ventral and dextral parietes of the abdomen removed to show the primary branches of the air-tubes on the right side. These may be observed to radiate from the spiracles, the ventral branches only being connected together by a longitudinal lateral canal, usually regarded as the principal trunk of the respiratory system of insects. This preparation is alluded to in the following passage from the Hunterian MS. '*Observations on Insects*.' "In a small Mole-cricket, which I supposed to be a male, I found the air-ducts of a dark colour, very regular, one on each side of the abdomen, communicating across, a good deal like the Silk-worm when it is casting its coat." Dr. Kidd observes (Anatomy of the Mole-cricket, *Phil. Trans.* 1825. p. 232.), "Now certainly in the Gryllotalpa, and, as I have reason to believe, in many other insects also, the longitudinal tracheæ bear so small a proportion in their capacity to the aggregate capacity of the other tracheæ, that in such instances they cannot be called principal tracheæ. My own opinion is, that these longitudinal tracheæ serve as connecting channels, by which the insect is enabled to direct the air to particular parts for occasional purposes." The appearances in the Hunterian preparation correspond with the above observation.

1077. A Stag-beetle (*Lucanus Cervus*, LINN.), with the dorsal parietes of the body removed to show the cellular interspaces of the muscles and viscera, distended with red injection. The venous blood is similarly diffused over the body, and the air is accordingly carried by the ramifications of the tracheæ through every part, for the purpose of effecting the respiratory change upon the slowly circulating fluids.

1078. A Humble-bee (*Bombus terrestris*, LATR.) similarly prepared.

1079. A similar specimen with the ventral parietes of the abdomen removed, showing the dilated crop, or honey-bag, covered with ramifications of the air-tubes.

1079 A. A Cock-chaffer (*Melolontha vulgaris*, FABR.), with the dorsal parietes of the body removed to show the oval membranous vesicles into which the air-tubes are dilated at various parts, and which serve as a reservoir of air. *Prepared by Mr. Owen.*

SERIES IV. Aeration of the Blood by means of Lungs.

"The species of apparatus for breathing air, which I call Lungs, differ greatly in their structure, having a regular gradation from one structure to another. The two great extremes of their differences are these,—the one is, where the internal surface is large in proportion to the size of the cavity; and the other, where the extent of surface is less in proportion to the size of the cavity. This occasions the animals possessing them to breathe differently: the first obliges them to breathe quickly; the other allows of slower respiration.

"The first of these structures is where the lungs are divided into innumerable cells, which are larger or smaller according to the body of the lungs. This structure obliges the animal to breathe more frequently, a small quantity of air being divided and applied to a vastly greater extent of surface and number of exhaling vessels, which therefore much sooner effects its purposes, and a quicker expulsion is necessarily produced.

"Those animals which have larger cavities in proportion to their surface, in order to keep up a due proportion between them, have commonly two large lungs with few or no cells. This structure allows the air to be confined for a longer space of time, as it is longer before it can answer its purpose." *Hunterian MS. Catalogue.*

A. *Where the air is applied to the external surface of the respiratory membrane.*

1080. The egg of a Goose (*Anas Anser*, LINN.), injected, and with the shell removed, in order to show the allantois, or vascular bag, which lines the shell and serves as a temporary lung to the chick during incubation. When the development of the chick has advanced so far as to the distinct formation of the four extremities, the circulating fluid then requires a distinct organ for its purification. This is effected by the growth of a small vesicle from the lower part of the intestinal canal, which rapidly expands, and, insinuating itself between the yolk and the white, attains to and spreads itself over the whole inner surface of the shell. The umbilical arteries and veins are coextended with, and ramify over it;

and the air permeating the porous shell is applied to the blood in this state of minute division, and the requisite respiratory change is thus effected.

B. *Where the air is applied to the internal surface of the respiratory membrane.*

1. *In Mollusks.*

1081. The soft parts of a Snail (*Helix pomatia*, Linn.). The pulmonary sac, which receives the air by an anterior orifice on the right side of the neck, is laid open from that orifice to the opposite extremity, and the roof of the cavity, upon which the pulmonary artery or continuation of the veins of the body ramifies, is turned back to show the reticulation of the vascular and respiratory surface. The parts have been injected with size and vermilion.

1082. A similar specimen, with the left parietes of the pulmonary sac removed, and the orifice by which the air is admitted and expelled left entire.

1083. The portion of the vascular parietes of the pulmonary sac, removed from the preceding preparation, and inverted, to show the ramifications of the pulmonary vessels. These are continued from the veins of the body without the interposition of a propelling ventricle.

1084. A similar preparation.

1085. The roof of the pulmonary sac of another specimen of *Helix pomatia*, with the vessels injected.

1086. A similar specimen, with a bristle inserted into the rectum, which terminates close to the orifice of the pulmonary sac.

1087. A Slug (*Limax ater*, Linn.), with the pulmonary sac laid open, showing the vascular and reticulate surface continued over the floor as well as the roof of the respiratory cavity. The mucous or urinary gland may also be observed surrounding the pericardium. Bristles are inserted both into the orifices of the gland and air-bag.

2. *In Reptiles.*

"The vessels of the lungs of those animals whose whole blood passes through them are confined to the lungs, and lungs only, as distinctly as if the lungs were a separate animal*; but this is not the case with the *Amphibia*, for we find the vessels of the lungs of the Turtle communicate with those of other parts, such as the vessels of the œsophagus, which shows that the blood of that part is not so perfect in them as in others. From this it must appear that the lungs are not of that consequence in this class of animals that they are in the more perfect, for the lungs themselves appear to share in common with the other parts. Some of the blood which just came from the lungs returns back again to them, which would appear to answer no purpose; and, on the other hand, a considerable quantity of the blood which had undergone the general circulation (and therefore would appear to require refinement), just returns through the same course. It would appear from this admixture, that it was not necessary that the whole of the blood should have undergone a thorough change for its greatest motion; yet we do not see why the lungs should have a part of their blood of the perfect kind.

"The cells of the lungs of the *Amphibia* seem to increase in size, the further from the trunk or trachea, so that the trachea and its ramifications bear no proportion between them and the cells."

Hunterian MS. Catalogue.

1088. The anterior part of a Snake (*Coluber natrix*, LINN.), with the ventral parietes removed to show the single lung *in situ*. It is a simple elongated sac, with the parietes, composing its anterior fourth, highly vascular and spongy, for effecting the respiratory change in the blood; but gradually assuming a thin membranous and slightly vascular structure, to serve as a reservoir of air.

1089. A longitudinal section of the lung of a Water Snake (*Pelamis bicolor*, DAUD.), showing the continuation of a tracheal canal along the lung, for the passage of the air to the lower or posterior part of the respiratory cavity.

1090. A similar section from the lower part of the lung of the same Snake.

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* "However simply as to its use, it would appear not to be so necessary as we imagine, as in inflammation we find a communication between them and the vessels of the body."

1091. A longitudinal section of the lung of a Rattle-snake (*Crotalus horridus*, LINN.), showing the delicate reticulation of its internal surface, and the termination of the tracheal canal, which is continued down the ventral side of the lung.

1092. A longitudinal section of the respiratory portion of the lung of a large poisonous Serpent (*Pseudo-boa*, OPPEL), showing its reticular structure, and the gradual diminution in the thickness and vascularity of the parietes as it recedes from the trachea, which here terminates at once at the commencement of the lung.

1093. A portion of the lung of the same Serpent. It has been minutely injected, and affords a beautiful example of the honeycomb structure of the parietes of the respiratory sac of these reptiles.

1093 A. The lungs of a large Serpent (*Python Tigris*, DAUD.). They have been minutely injected, and are laid open to show the extent of the vascular respiratory portion, which is nearly the same in both, but the right lung is principally prolonged to form the reservoir. A part of the trachea, the two pulmonary arteries, and single pulmonary vein are also preserved.

Prepared by Mr. Owen.

1094. A Slow-worm (*Anguis fragilis*, LINN.), with the ventral parietes of the body removed to show the lungs. These are of a membranous structure and of small extent: the left is about half the size of the right.

1095. A Newt (*Triton palustris*, LAURENTI), with the ventral parietes of the body removed to show the lungs *in situ*. These consist of two thin membranous sacs, which reach to the pelvis. The cranium is removed to show the simple laryngeal aperture at the root of the tongue, in which aperture a bristle is inserted.

1096. The lower jaw, anterior extremities, and lungs of a Newt, injected, to show the form, structure, and vascularity of the pulmonary sacs.

1097. The lung of an Amphibious Reptile. It is of an elongated pointed form, finely notched along the anterior margin.

1098. A Frog (*Rana temporaria*, LINN.), with the lungs injected *in situ*. The left lung has been laid open to show the cellular parietes, and the extent to which they encroach upon the cavity of the lung.

1099. A single lung of the Frog injected, and laid open.

1100. A single lung of a Toad (*Bufo vulgaris*, Laurenti). Its parietes are cellular, like those of the Frog, but thinner.

1101. The lungs of a large Batrachian. One of them is laid open, showing it to be more minutely cellular than the preceding.

1102. The lungs and larynx of a Bull-frog (*Rana pipiens*, Linn.). A small accessory pouch is appended to each pulmonary sac.

1103. A Surinam Toad (*Pipa monstrosa*, Laur.), with the ventral parietes of the abdomen reflected to show the thin membranous lungs *in situ*: they are of considerable breadth, and extend downwards to the pelvis, as in the Chelonian Reptiles.

1104. The lower portion of one of the lungs of the Surinam Toad, showing its large cells, and their dense and slightly vascular parietes, being adapted at that part to serve as a reservoir of air.

1105. The lungs of a Chameleon (*Chameleo planiceps*, Merrem). These are remarkable for their size, for the delicacy of their parietes, and the number of elongated cæcal processes continued, like the air-cells of birds, from their anterior and inferior margins. Each lung is partially divided longitudinally at its superior part into two cavities, which have their vascular surface increased by subdivision into cells for the purpose of respiration. The inferior appendiculated part of the lung is of a simpler structure, and serves as a reservoir of air.

1106. The lungs of a Chameleon, showing the simple membranous structure of the cæcal processes or appendages.

1107. A longitudinal section of one of the lungs of an Iguana (*Iguana tuberculata*, Linn.), showing the size of the cavity, and the relative vascularity and complication of structure of its parietes.

1108. The opposite section of the same lung, showing the smaller divisions of the general cavity, and the spongy structure and vascularity of the septa which form their parietes.

1109. A longitudinal section of the opposite lung of the same Iguana, minutely injected, and afterwards inflated and dried. In this preparation is beautifully shown the reticulate disposition and anastomoses of the pulmonary vessels in which the blood is submitted to the atmospherical influence; and the whole may be regarded as representing a magnified view of one of the minute and innumerable air-cells into which the lungs of the *Mammalia* are subdivided.

1109 A. A longitudinal section of one of the lungs of a Tortoise (*Chelydra serpentina*, SCHWEIGGER). This presents a further stage in the complication of the lung: the general cavity is divided into eight compartments, and the vascular respiratory surface is consequently increased. The subdivision of the parietes into cells is greatest at the upper or anterior part of the lung, as in the preceding examples. The bronchia extends to the lowest compartment of the lung, and its ligamentous structure is continued over the margins of all the larger cells.

Prepared by Mr. Owen.

1110. A young Turtle (*Chelonia Caretta*, BROGN.), with the ventral parietes of the body removed to show the lungs *in situ*, which extend over all the back part of the abdomen down to the pelvis.

1110 A. The lung of a Green Turtle (*Chelonia Mydas*, BROGN.) injected and laid open, showing the extension of the respiratory surface by numerous additional divisions of the general cavity, each of which is again subdivided into cells. *Mus. Brookes.*

1111. A section of the lung of a Turtle injected, in which the bronchia and its ramifications are laid open, and the cellular structure of the lungs is well displayed.

1112. Another section of the same lung, showing the termination of the bronchia, and the continuation of the cellular structure to the extremity of the lung.

1113. A section of the lung of a Turtle, taken from the outer margin, where the cells are largest, and their parietes least vascular.

1114. A section of the lung of a Turtle, showing the diameters of several of the primary divisions of the bronchia, and their mode of communication with the cellular structure of the lung.

1115. A similar section, showing the termination of the primary divisions of the bronchia.

1116. A section of the bronchia with part of the lung of a large Turtle, showing the continuation of the cartilaginous rings along the air-tube after it has penetrated the lung.

1117. A section of the lung of a Hawksbill Turtle (*Chelonia imbricata*, Brogn.), the structure of which is denser than in that of the Green Turtle.

1118. A longitudinal section of one of the lungs of a Crocodile (*Crocodilus acutus*, Cuv.). The bronchia enters the middle of the lung, and is continued for the extent of an inch into its substance before it loses its cartilaginous annular structure; it then abruptly terminates in a dilated elongated passage, similar to those in which the side branches of the bronchia open. These passages correspond with the primary divisions of the pulmonary cavity in the preceding specimens, and the air passes from them by numerous round apertures into the smaller subdivisions, forming the cellular structure of the lung.

1119. Another section of the upper extremity of the same lung, showing its structure, and the communication of the primary elongated passages by means of large cells at the periphery of the lung.

1120. Another section from the lower extremity of the same lung, where the cells are smaller and more numerous than at the upper. These preparations of the Crocodile's lung have been minutely injected.

1121. A longitudinal section of a lung of a smaller Crocodile, showing the continuation and mode of termination of the bronchia in the lung, and the structure of the latter.

1122. A similar section of a lung of the same animal, in which the primary passages have been laid open to their termination at the periphery of the lung, where their intercommunications are seen.

1123. A section of one of the lungs of an Alligator, with three of the primary air passages, laid open to show the orifices by which the air passes from them to the smaller cells and subdivisions of the lung.

3. *In Birds.*

1124. The termination of the trachea, inferior larynx, bronchiæ, and lungs of a Drake (*Anas Boschas*, Linn.). The entire cartilaginous rings of the trachea, the sterno-tracheal muscles, the terminal bone of divarication, the dilated laryngeal receptacle for vibratory air, the more delicate rings of the bronchiæ and their compressed form are well displayed. The lungs are undivided bodies and minutely cellular throughout; they are notched along their posterior margins, from being closely impacted in the intervals of the ribs at the back of the chest, and they have the whole of their outer surface connected to the surrounding parts, to ensure their dilatation and compression in the changes of the capacity of the chest produced by the respiratory actions. The necessity of this general adhesion arises from the continuation of several of the ramifications of the bronchia through the substance of the lung into air-cells, which extend into the abdomen like the lungs of reptiles, and are also continued into various parts of the body, even into the osseous system, to an extent varying in different birds.

1125. The corresponding parts, together with the heart and great vessels of a Fowl (*Phasianus Gallus*, Linn.), to show their relative positions. The orifices of the bronchia on the surfaces of the lungs which communicated with the air-cells are here very conspicuous.

The pulmonary artery arises to the left of the aorta, the early division of which gives the appearance of there being three great primary trunks, as in reptiles. The affinity of birds to the cold-blood *Ovipara* is further exemplified by the continuation of the aorta over the right bronchia, instead of the left, as in the mammiferous animals.

1126. A transverse section of the lungs and posterior part of the thorax of a Fowl, showing how the lungs are confined to the posterior part of the cavity; as also their adhesion to the surrounding parts, especially to the membrane in which the small diaphragmatic muscles are inserted.

1127. A portion of the superficies of a lung of the Ostrich, showing the large size of the pulmonary cells at that part.

4. *In Mammalia.*

1128. The anterior part of a Mole (*Talpa Europæa*, Linn.), showing the lungs injected, *in situ*. Their position appears to be lower or further back than in other Mammalia, in consequence of the considerable space in front of the chest, which is occupied by the powerful muscles of the anterior extremities. The heart is turned to the left side, and the middle lobe of the right lung extends across the chest to the same side. The diaphragm, which in Mammalia forms a strong partition between the chest and abdomen, is here remarkably muscular, and the central tendon is consequently reduced to a very small size.

1128 A. The trunk of a human fœtus, injected, from which the anterior parietes of the thorax and abdomen have been removed to show the contained viscera *in situ*, but more especially the lungs. These organs are here, as in other Mammalia, freely suspended in the thoracic cavity, and advance forwards so as almost to conceal the heart, which is indicated by a bristle.
Presented by Sir Wm. Blizard, F.R.S.

1129. The heart and lungs of a Kitten (*Felis domestica*, Linn.). This preparation shows principally the subdivision of the lungs into many lobes, and more especially the small azygos lobe of the right lung, filling up the space which intervenes between the heart and diaphragm in this and most other quadrupeds.

1130. The termination of the trachea, the bronchiæ, and lungs, injected, of a Rat (*Mus decumanus*, Pallas). The right lung is divided into three lobes, besides the azygos or middle lobe, which is of large size; the left lung consists of a single lobe.

1131. A section of a lung of a Dromedary (*Camelus dromedarius*, Linn.). It shows the continuation of the cartilaginous rings into the smaller ramifications of the bronchiæ; but has been preserved, according to the MS. Catalogue, on account of the fat which is accumulated on the edge of the lung.

1132. A small portion of the lung of a Porpesse (***Phocæna communis***, Cuv.), showing the terminations of the ultimate ramifications of the bronchiæ in the minute air-cells; and the continuation of the cartilaginous rings into the bronchial ramifications.

1133. A similar preparation. (Plate XXVIII. fig. 2.)

1134. The lobe of a lung of some small Quadruped, with the air-cells injected with mercury.

1135. A small portion of a lung of an Elephant (*Elephas Indicus*, Cuv.), with the air-cells similarly injected with mercury: dried, and preserved in oil of turpentine.

1136. A small portion of Human lung, of which the air-cells have been filled with mercury, showing their minute size: dried, and preserved in oil of turpentine.

1137. A similar specimen.

1138. A small portion of Human lung, injected with size and vermilion.

1139. A similar specimen.

1140. A similar specimen, in which the extreme air-cells have been preternaturally dilated and broken down.

Series V. Siphon, or Tube conducting Water to Gills.

1141. The siphon, with a portion of the branchial chamber and gills of a Volute (*Voluta*, Lam.). The siphon is elongated, of a tubular form, but open through its whole length, and with two appendages at its base. The muscular fibres of which it is composed are arranged chiefly in the circular direction, but the exterior ones are longitudinal. The branchiæ consist of three rows of transverse close-set laminæ.

1142. A Pholas (***Pholas crispata***, Linn.). The muscular tube, or siphon, by which the specimen is suspended includes two canals; the one furthest from the hinge conveys the respiratory currents to the branchial chamber, the other serves as an outlet to the excrements.

SERIES VI. Trachea, or Tube conducting Air to Lungs.

1143. A transverse section of the Human trachea. It is composed of a series of cartilaginous hoops or rings, incomplete behind, and connected together by dense and elastic cellular tissue, and by a mucous membrane which lines the tube.

1144. A portion of the Human trachea, laid open by an anterior longitudinal section, showing the orifices of minute mucous glands, which are situated principally on that part of the lining membrane corresponding to the posterior interspace of the cartilaginous rings.

1145. A transverse section of the trachea of a Horse (*Equus Caballus*, LINN.). The cartilaginous rings are incomplete behind, as in most quadrupeds; but the unattached ends are flattened and expanded, and overlap each other. The diameter of the windpipe is regulated by muscular fibres, which pass transversely across the back part of the tube from one side of the cartilaginous rings to the other, being attached, not to the free extremities, but at the angle where these are bent inwards.

1146. A single cartilaginous ring from the trachea of a Horse.

1147. A section of the trachea of a Sheep (*Ovis Aries*, LINN.). The cartilaginous hoops meet posteriorly at an acute angle, and do not overlap each other; the narrow interspace thus formed is filled up with cellular membrane, so as to leave the area of the tube of a circular form.

1148. A section of the trachea of an Ox (*Bos Taurus*, LINN.). It is laid open longitudinally to show the thickness of the cartilaginous rings, and the longitudinal rugæ of the lining membrane.

1149. A section of the trachea of a Fallow-deer (*Cervus Dama*, LINN.), showing the locking together of the cartilaginous rings, those which overlap the two contiguous rings anteriorly being reciprocally overlapped by them posteriorly.

1150. A section of the trachea of a Giraffe (*Camelo-pardalis Giraffa*, LINN.). The posterior part of the tube has been removed to show the thickness of the rings and their imbricated disposition.

1151. A smaller section of the same trachea, showing the expanded and attenuated posterior extremities of the cartilaginous rings: those of the right side are blended together in the portion here preserved.

1152. A single cartilaginous ring of the same trachea.

1153. The termination of the trachea and bronchiæ of a Kangaroo (*Macropus major*, SHAW), with several bronchial glands, of the usual dark colour, attached.

1154. A considerable portion of the trachea, with the lungs and heart, of a Sloth (*Bradypus tridactylus*, LINN.). The trachea, in this singular animal, passes down the right side of the posterior part of the chest to the diaphragm, then is bent abruptly upon itself, ascends, and after another slight curve, divides about the middle of the chest into the bronchiæ. Each lung is composed of a single lobe, and the air-cells are larger than in most other Mammalia.

1155. A section of the trachea of an Ostrich (*Struthio Camelus*, LINN.). The rings are narrow and entire, as in the rest of the class of birds; but they retain their cartilaginous texture. One of the longitudinal muscles of the trachea is left attached.

1156. Another section of the same trachea, from which the posterior part of the tube has been removed to show the thinness of the rings, and the smoothness of the lining membrane. Both the lateral longitudinal muscles, analogous to the *sterno-thyroidei* of Mammalia, are preserved; these regulate the length of the air-tube, and accommodate it to the varied and extensive motions of the neck.

SERIES VII. Larynx, or Organ of Voice.

1. *In Reptiles.*

1157. The tongue, os hyoides, larynx, and part of the trachea of a Hawksbill Turtle (*Chelonia imbricata*, BROGN.). The aperture of the larynx is a simple longitudinal fissure, undefended by retroverted papillæ, or by an epiglottis, but capable of being accurately closed by its constrictors. The trachea is composed of entire cartilaginous rings, as in the preceding specimens from the Ostrich.

2. *In Birds.*

1158. The tongue, pharynx, and superior larynx of the Curassow (*Crax Alector*, Linn.). The orifice of the larynx, as in the cold-blooded *Ovipara*, is a longitudinal fissure, which in birds is protected during deglutition by the papillæ, which project backward from the base of the tongue, and is here further defended by a process extending backwards into the cavity of the larynx from the middle of the anterior surface.

1159. The termination of the trachea and the bronchiæ of an Ostrich. The longitudinal or sterno-tracheal muscles are here seen as they pass from the sternum to expand upon the sides of the trachea. At the termination of this tube the tracheal rings become thickened, rounded, and are protruded outwards so as to leave a cavity on either side, which is filled up with elastic substance, which also extends into the area of the tube like a *chorda vocalis*, immediately above the commencement of each bronchia: this vocal apparatus is not further complicated either by a bone of divarication or other appendage. The bronchiæ are provided with slender rings, are of the usual flattened form at their commencement, and rapidly diminish in size as they recede from the trachea.

1160. A part of the trachea, with the inferior larynx and bronchiæ, of a Gannett (*Sula Bassana*, Brisson.) In this bird there is a second pair of muscles in addition to the pair of sterno-tracheal muscles exhibited in the preceding preparations: they appear like slips of the *sterno-tracheales* continued downwards, to be inserted into two small glandular masses lodged in depressions outside the origins of the bronchiæ.

1161. The inferior larynx of a Raven (*Corvus Corax*, Linn.), with a portion of the trachea, showing five pairs of muscles belonging to the organ of voice. From each lateral muscle of the trachea, besides the slip continued to the sternum, there is one anterior portion which goes to be inserted into the last ring of the trachea, and one posterior slip which is attached to the first bone of the bronchia. The fourth muscle arises from the end of the trachea, and is inserted into the first semicircular bone of the bronchia. The fifth muscle has a similar origin, and is also attached to the first bronchial bone.

1162. The inferior larynx and part of the trachea of a Bird, laid open to show the bone which traverses, from before backwards, the extremity of the trachea at the angle of division into the bronchiæ, and which supports the tympaniform membrane of the latter tubes.

1163. The inferior larynx of a Drake (*Anas Boschas*, Linn.), laid open posteriorly to show the large bone of divarication, and the dilated osseous cavity at the commencement of the left bronchia.

1164. The inferior larynx of a Drake, in which the bony dilatation has been opened on one side to show its communication with the bronchia and trachea, and on the opposite side the bronchia and trachea are laid open to show the bone of divarication.

1165. The entire trachea, with the superior and inferior larynges of the Goosander (*Mergus Serrator*, Linn.). The superior aperture is a simple longitudinal cleft, undefended, as in other Ovipara, by an epiglottis. The trachea presents a dilatation at its anterior third, and there is a remarkable bony cavity at the termination of the trachea, from which both bronchiæ are continued.

2. *In Mammalia.*

1166. The longitudinal section of the head of a Porpesse (*Phocæna communis*, Cuv.), showing the pyramidal larynx projecting into the posterior nares, and embraced by the muscles of the soft palate, which surround it like a sphincter, and cut off all communication between the mouth and nostrils. A quill is placed in the laryngeal aperture.

1167. A longitudinal section of the tongue, pharynx, and larynx of a Porpesse. The pyramidal portion of the larynx, which crosses the pharynx to penetrate the posterior nostrils, is composed of the arytenoid cartilages and epiglottis, which are peculiarly elongated and united by a common envelope of the mucous membrane, leaving at the apex a transverse semilunar aperture for the passage of the air. The laryngeal cavity intercepted by the cricoid cartilage is laid open, showing numerous orifices of mucous follicles upon its anterior and inferior surfaces. Bristles are inserted into the larynx and into one of the side passages of the pharynx, which is here left entire.

1168. The os hyoides and larynx of a Porpesse. The thyroid cartilage, from the great extension of the inferior cornua, appears to be composed of two semilunar pieces joined by the anterior extremities. The cricoid cartilage is incomplete anteriorly. The larynx is laid open posteriorly to show the origins of the arytenoid cartilages at its anterior part, and the consequent absence of any vocal ligaments. Between these elongated cartilages and the root of the similarly elongated epiglottis, to which they are connected, there are two lateral glandular fossæ, which may be considered analogous to laryngeal sacculi.

1169. The tongue, larynx, and pharynx of a Porpesse, showing the division of the fauces into two passages, along which quills are placed indicating the course of the food in deglutition on either side the pyramidal larynx.

1170. The larynx and pharynx of a Dolphin (*Delphinus Tursio*, Fabr.), showing anteriorly the above-mentioned division of the fauces by the extension of the larynx upwards, and posteriorly the continuation of the laryngeal and nasal passages by the sphincteric disposition of the soft palate around the conjoined extremities of the arytenoid and epiglottidean cartilages. The commencement of the œsophagus and trachea is also shown.

" *Of the Larynx.*

" The larynx in most animals living on land is a compound organ, adapted both for respiration, deglutition, and sound, which last is produced in the actions of respiration; but in this tribe the larynx, I suppose, is only adapted to respiration, as we do not know that they have any mode of producing sound.

" It is composed of os hyoides, thyroid, cricoid, and two arytenoid cartilages, with the epiglottis. It varies very much in structure and size, when compared in animals of different genera. These cartilages were much smaller in the Bottle-nose of twenty-four feet long, than in the Piked Whale of seventeen feet, while the os hyoides was much larger.

"In the Bottle-nose the os hyoides is composed of three bones, besides two whose ends are attached to it, being placed above the os hyoides, making five in all. In the Porpoise, Piked Whale, &c., it is but one bone, slightly bent, having a broad thin process passing up, which is a little forked: it has no attachment to the head by means of other bones, as in many quadrupeds.

"The thyroid cartilage in the Piked Whale is broad from side to side, but not from the upper to the lower part: it has two lateral processes, which are long, and pass down the outside of the cricoid near to its lower end, and are joined to it much as in the human subject. These differ in shape in different animals of this tribe.

"The cricoid cartilage is broad and flat, making the posterior and lateral part of the larynx, and is much deeper behind, and laterally, than before. It is extremely thick and strong, flattened on the posterior surface, and hollowed from the upper edge to the lower. It terminates by a thick edge on the posterior part above, but irregularly at the lower edge in the cartilages of the larynx.

"The two arytenoid cartilages are extremely projecting, and united to each other till near their ends; are articulated on the upper edge of the cricoid, but send down a process, which passes on the inside of the cricoid, being attached to a bag in the Piked Whale, which is formed below the thyroid and before the cricoid cartilages: they cross the cavity of the larynx obliquely, making the passage at the upper part a groove between them: the cavity at this place swells out laterally, but is very narrow between the anterior and posterior surfaces. The passage above, between the arytenoid and thyroid cartilages, is wide from side to side, and is continued down on the outside of the processes of the arytenoid cartilage, as well as between them, ending below the thyroid, which is folliculated on its inner surface on the fore part of the cricoid cartilage.

"The epiglottis makes a third part of the passage, and completes the glottis by forming it into a canal in several of this tribe; but in the Piked Whale it was not attached to the two arytenoid cartilages, but only in contact, or inclosing them at their base, so as to make them form a complete canal." ....

" *The Blow-hole, or Passage for the Air.*

" As the nose in every animal that breathes air is a common passage for the air, and is also the organ of smelling; I shall describe it in this tribe as instrumental to both these purposes.

"There is a variety in some species of this animal which is, I believe, peculiar to this order; that is, the want of the sense of smelling; none of those which I have yet examined having that sense, except the two kinds of Whalebone Whale: such of course have neither the olfactory nerves, nor the organ; therefore, in them, the nostrils are intended merely for respiration; but others have the organ placed in this passage as in other animals.

" The membranous portion of the posterior nostrils is one canal, but when in the bony part, in most of them, it is divided into two; the Spermaceti Whale, however, is an exception. In those which have it divided, it is in some continued double through the anterior soft parts, opening by two orifices, as in the Piked Whale; but in others it unites again in the membranous part, making externally only one orifice, as in the Porpoise, Grampus, and Bottle-nose. At its beginning in the fauces it is a roundish hole, surrounded by a strong sphincter muscle for grasping the epiglottis; beyond this the canal becomes larger, and opens into the two passages in the bones of the head. This part is very glandular, being full of follicles, whose ducts ramify in the surrounding substance, which appears fatty and muscular like the root of the tongue, and these ramifications communicate with one another, and contain a viscid slime.

" In the Spermaceti Whale, which has a single canal, it is thrown a little to the left side. After these canals emerge from the bones near the external opening they become irregular, and have several sulci passing out laterally, of irregular forms, with corresponding eminences. The structure of these eminences is muscular and fatty, but less muscular than the tongue of a quadruped.

" In the Porpoise there are two sulci on each side, two large and two small, with corresponding eminences of different shapes, the large ones being thrown into folds. The Spermaceti Whale has the least of this structure; the external opening in it comes farther forwards towards the anterior part of the head, and is consequently longer than in others of this order. Near to its opening externally it forms a large sulcus, and on each side of this canal is a cartilage which runs nearly its whole length. In all that I have examined, this canal, forwards from the bones, is entirely lined with a thick cuticle of a dark colour.

"In those which have only one external opening it is transverse, as in the Porpoise, Grampus, Bottle-nose and Spermaceti Whale, &c.; where double they are longitudinal, as in the Piked Whale and the large Whalebone Whale. These openings form a passage for the air in respiration to and from the lungs, for it would be impossible for these animals to breathe air through the mouth; indeed I believe the human species alone breathes by the mouth, and in them it is mostly from habit, for in quadrupeds the epiglottis conducts the air into the nose.

"In the whole of this tribe the situation of the opening on the upper surface of the head is well adapted for this purpose, being the first part that comes to the surface of the water in the natural progressive motion of the animal; therefore it is to be considered principally as a respiratory organ, and where it contains the organ of smell, that is only secondary.

"As the animals of this order do not live in the medium which they inspire, the organs conducting the air to the lungs are in some sort particularly constructed, that the water in which they live may not interfere with the air they breathe.

"The projecting glottis, which has been described, passes into the posterior nostrils, by which means it crosses the fauces, dividing them into two passages. The enlargement at the termination of the glottis observed in some of them would seem to be intended to prevent its retraction; but as it seems confined to the Porpoise and Grampus, it may, perhaps, in them answer some other purpose.

"The beginning of the posterior nostrils, which answers to the *palatum molle* in the quadruped, having a sphincter, the glottis is grasped by it, which renders its situation still more secure; and the passages through the head, across the fauces, and along the trachea, are rendered one continued canal. This union of glottis and epiglottis with the posterior nostril, making only a kind of joint, admits of motion, and of dilatation and contraction of the fauces, in deglutition, from the epiglottis moving more in or out of the posterior nostrils. This construction of parts answers a purpose similar to that of the epiglottis in the quadruped; it may be considered as the epiglottis and the arytenoid cartilages joining to make a tubular or cylindrical epiglottis, instead of a valvular one. The reasons why there should be so peculiar a construction of parts do not at first appear; but we certainly see by it an absolute guard placed upon the lungs, that no water should get into them.

"This tribe being without the projecting tongue of the quadruped, and wanting its extensive motion and the power of sucking things into the mouth, may probably require the construction between the air and lungs to be more perfect; but how far it is so I will not pretend to say."
Hunter, On Whales, Phil. Trans., vol. lxxvii. p. 416. (1787.)

1171. The larynx, pharynx, and root of the tongue of a Paca (*Cœlogenys subniger*, Cuv.). The soft palate here extends to the base of the tongue, so that the epiglottis projects into the posterior nares, as in the Cetacea, but the laryngeal aperture is not surrounded by the pharyngeal constrictors. The mucous membrane is continued from the epiglottis to the apices of the arytenoidei, but at the bottom of the cavity so formed the two chordæ vocales may be distinctly seen.

1172. The cartilages of the larynx of a Lion (*Felis Leo*, Linn.), showing the large size of the vocal organ, and the rounded contour of the epiglottis in this species of *Felis*. From the narrowness of the thyroid cartilage anteriorly, there is a considerable interval at that part between the thyroid and cricoid cartilages, a structure which obtains in all the feline animals.

1172 a. The larynx of a Jackall (*Canis aureus*, Linn.). It is laid open posteriorly and shows the large and well marked inferior ligaments, or chordæ vocales, and the deep laryngeal sacculi. The epiglottis is triangular; the muscle which passes from its base to the tongue is seen in transverse section: other muscles, as the *crico-thyroidei*, the *thyreo-epiglottidei*, and *intercornuales*, are also seen to be strongly developed. *Prepared by Mr. Owen.*

1173. The larynx of a white or albino variety of Baboon (*Cynocephalus,—an Sphingiola?* HERMANN). The body of the os hyoides is expanded into a hemispherical cavity, of which one half has been removed to show the sacculus of the lining membrane of the larynx continued into it from below the epiglottis; in addition to which there are two lateral sacculi.

1173 A. The larynx of a Monkey (*Macacus Cynomolgus*, CUV.). It is laid open posteriorly to show the chordæ vocales, and the lateral and mesial sacculi laryngis: a bristle is placed in the latter, which is continued into the triangular cavity formed by the body of the os hyoides. The thyroid gland is preserved *in situ*. *Prepared by Mr. Owen.*

1173 B. The larynx and thyroid gland of the Orang-utan (*Simia Satyrus*, LINN.). In this Quadrumanous animal, which approximates the human species so closely in its general organization, there is no mesial sacculus laryngis, but the lateral sacculi are greatly developed, extending outwards between the thyroid cartilage and os hyoides. The one on the right side is here preserved entire; the opposite one has been cut off, and a bristle is passed through the aperture, by which it communicates with the larynx. In the adult Orang these sacculi extend over the whole neck and part of the chest. The thyroid gland is proportionately much smaller than in Man. *Prepared by Mr. Owen.*

1173 C. The larynx of the Chimpanzee (*Simia Troglodytes*, LINN.). It is laid open posteriorly, and shows two lateral sacculi laryngis, which are more developed than in Man, but not produced to the same extent as in the preceding species. They extend upwards and outwards, and the left sacculus is continued forwards below the body of the os hyoides, which is slightly expanded and hollowed out for its reception. *Prepared by Mr. Owen.*

1174. The larynx, with part of the tongue and pharynx of the human subject. The larynx is laid open posteriorly to show the lateral sacculi and the chordæ vocales.

1175. The cricoid and arytenoid cartilages of the human larynx.

SUBDIVISION VI.

URINARY SYSTEM.

"THE bodies called Kidneys are glands intended for a secretion of a fluid, which in common language is called urine. Their use is immediately to carry out of the circulation such parts as are useless and obnoxious, becoming the common-sewer of the constitution; but those parts must be carried off by a change being performed in them, constituting a secretion.

"These bodies probably do not exist in every animal, at least they are not to be found in every one, most of the inferior orders of animals having visibly no such bodies, which is one mark of their inferiority, although it is probable that in them other common parts may serve the same purpose, or perform the same action; for instance, it is probable that the intestines of such perform the same office.

"As these bodies, in those animals which possess them, are to perform an office peculiar to themselves, they are distinct parts from all others in the body.

"They are, from Fish upwards, in pairs; but below Fish, as in the Cuttle-fish, Snail, &c., there appears to be only one.

"Their situation in the body varies in different animals.

"From Fish upwards they may be said to be placed within the belly of the animal, near to the back; but below them, in the inferior orders, where both their number and situation are not the same with those where they are evident, it becomes uncertain whether such bodies, whose use is not immediately seen or obvious, are the kidneys or not; nor is it so determined where they may be placed; as, for example, in the Cuttle-fish the kidney is in the anterior part of the belly, in the Snail by the lungs.

"In some orders of animals they are very circumscribed bodies, being inclosed in a proper membrane or capsule, as in the most perfect orders, and in some degree so in Amphibia; but in Fowl they are more obscure, being placed in the hollows of the pelvis; while in Fish they are still less detached, lying all along the sulcus made by the spine, and are closely attached to the parts behind, not having there any particular capsule.

"In some animals the kidney is a very oblong body, extending in length for a considerable way, and very narrow, as in some Fish, while in other animals it is almost globular, as in the Leopard.

"In some the external surface is smooth and regular, as in the Human; in others covered with large branches of veins ramifying on it, as in the Lion tribe, &c. In others, again, the whole mass is lobulated into several parts, and very irregular on its surface.

"The consistence of the kidney is in general a pretty solid substance, but most so in the most perfect animal, appearing to become less and less so to the inferior orders, for in Fish they are of a very tender substance, and still more so in the Snail.

"In the inferior orders of animals the kidneys are pretty much of the same uniform substance through the whole, but in the Quadruped they appear, when cut into, to be formed of two different substances, one called the *Cortical*, from its being exterior, the other the *Tubular*.

"The cortical substance has its distinguishing appearances from its vessels running in all directions, having no particular direction of fibres, and also having the cryptæ interspersed everywhere through its substance. The other substance, or tubular, is placed towards the centre of the kidney; when cut in one direction it appears to be made up of parts or fibres passing pretty parallel to one another towards the centre, and when torn in that direction it splits into numberless fibrous parts. This substance begins insensibly in the surrounding secretory part, and passing inwards, they of course converge and terminate at once, forming one side of a cavity, called the *Pelvis*.

"As the kidneys have another action of their blood-vessels superadded to that of support, similar to every other secreting body, and which is to dispose of some of the blood in secretion besides the nourishment to the part itself, they are therefore endowed with supernumerary blood-vessels for such purposes, and are of course extremely vascular when compared to many other parts of the body.

"These vessels in Fish and upwards arise from the great artery, or aorta, as that artery passes along the back-bone. In Fish this great artery is giving off the arteries to the kidneys through the whole course of the kidneys, therefore there are a vast number of small arteries going to those bodies. In Amphibia and Fowl the kidneys are more collected, and of course their arteries are less numerous, and larger in proportion; but in the still more perfect animals, where the kidneys are more circumscribed bodies, there we have in common only one artery to each kidney, which is of a very considerable size.

"In those kidneys where the arteries go into them in small branches, as in Fish, &c., there is not that necessity for their very quick ramifications, for being originally small, they come soon to their ultimate arteries; but in the others, where the artery goes into the kidney by one trunk, and therefore is large, it is obliged to ramify very quickly, in order to form the ultimate arteries.

"As the arteries of the kidneys in Fish come to them in innumerable small branches, and as the motion of the blood in those animals is slow and languid, the arteries therefore appear to terminate in their ultimate branches, as in other glands. But in the more perfect animals, especially the quadruped,—where the artery goes into the kidney in one short large trunk, where the motion of the blood is very rapid, and where they are obliged to terminate soon in the ultimate branches, which continue the rapidity of the blood's motion in them,—there we find that the arteries necessary for the performance of the secretion of urine, take on a little twist, convolution, or spiral turn, called *crypta*, intended for the retardment of the blood's motion, to allow of secretion; but the termination of every artery in the kidney has not these cryptæ; and as they are confined to the external parts of the kidney, they give a peculiar appearance to this part distinguishable from the rest, whence the substance of the kidney in this order of animals is divided into the two kinds above mentioned, viz. the cortical and the tubular.

"The veins of the kidney in common follow the arteries; however, there are exceptions to this rule. In the Lion kind, Cat kind, as also in the Hyæna, we find that perhaps one half of the veins get on the external surface, and are either strongly attached to, or pass in a doubling of the capsule of the kidney, and then pass along like the veins of the pia mater, afterwards joining the trunks from the inside just as they pass out*.

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* The following additional observations by Mr. Hunter on the vessels of the kidney are appended to the original MS. Catalogue.

"The kidney, like every other secreting gland, is composed of blood-vessels and excretory ducts.

"The blood-vessels are the arteries and veins. The arteries answer two purposes, viz. secretion and nourishment, similar to every other secreting part, and may be called nutritious and secretory. The

"The excretory ducts of kidneys in general may be reckoned intermixed everywhere with the secretory, forming a regular ramification of branches and trunks. The ultimate branches are of two kinds; first, where the excretory, or what may be called the first order of ducts, arise in every part of the kidney, then unite and form trunks, which may be called the second order, and these unite and form the third, and so on, forming at last the ultimate trunk, called the ureter, as in Fish, Amphibia, and Fowl. The second is where the secretory and excretory are pretty distinct, not intermixed as in the first, the secretory being the most external, the excretory the most internal; and where the excretory

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veins appear to act here, as in most other parts of the body, viz. simply to bring the blood back, and conduct it out of the kidneys to the veins common to them and other parts.

"With respect to the arteries, I believe that those of the kidneys may be divided into two classes. The first class is where the arteries ramify and go on through the substance of the kidney without any change, as in arteries in common. The second class is where they form (to appearance) small globular bodies called Cryptæ.

"Kidneys may be divided into the same classes with respect to the appearance of structure. The first corresponds to the former division respecting arteries, and it is where the structure is uniformly the same through the whole, arising from the secretory and excretory, or what is called cortical and tubular, being uniformly mixed, producing no distinction of parts. The second of this division is also the second of our first division respecting arteries, and is where it is apparently composed of two substances, viz. the secretory and excretory, which are distinct and have different appearances.

"The secretory part is only to be considered as vessels, and those principally the arteries, which I divided into two kinds, viz. continued Ramifications and Cryptæ. The first is in such animals where the motion of the blood in general is languid, as is the case in Fish and Amphibia, and to add to this slowness in such animals, the arteries pass to the kidneys in a number of small branches, especially in Fish. The second is in the quadruped, where the blood comes in one trunk, which of course allows the velocity of the blood to be very considerable; there we have in every artery of the kidney for secretion a twist in the smaller branches, by means of which the motion of the blood is lessened.

"The veins of the kidneys have in general nothing particular respecting them. They in common attend the arteries, or at least ramify similarly to the arteries, excepting in the Lion and Cat kind, as also in the Hyæna, where some of the veins ramify on the surface, while the others are attending the arteries." *Hunterian MS. Catalogue.*

It is here necessary to observe that in later researches a much greater importance has been assigned to the veins in the history of the Renal Organs. According to the researches of Prof. Jacobson of Copenhagen, there is a double venous circulation in the kidneys of the oviparous Vertebrata, analogous to that which obtains in the liver, and the urine is considered by that able physiologist to be secreted, like the bile, from venous blood. See his Essay, entitled "De Systemate Venoso peculiari in permultis Animalibus observato. Hafniæ, 1821." 'On a peculiar Arrangement of the Venous System observed in many Animals.'—*Edinburgh Medical and Surgical Journal*, vol. xix. p. 78.

do not at all unite into larger and larger branches, forming in the end one common trunk, as in the first, but where they all open into a cavity or reservoir, called pelvis, which is placed in a pretty deep sulcus in the inner edge of the kidney.

"The mode of opening into this reservoir admits of some variety, but may be divided first into two species. The first species is where the excretory ducts, after forming the second and third order, open into the pelvis on a concave surface, as in the Horse, Ass, &c.; the second is where they form a projection or projections, called mamma or mammilla, which are projected into this cavity, and the excretory ducts open on the point or edge of such.

"In some there is only one mammilla, and one infundibulum, as in the Lion tribe; in others there are a great many mammillæ and infundibula, as in the Bonassus." *Hunterian MS. Catalogue.*

SERIES I. Kidney.

SUBSERIES 1.—*Situation of the Kidney.*

a. *Where single.*

1176. The soft parts of a Snail (*Helix Pomatia*, LINN.) injected, and prepared to show the gland in the respiratory cavity which surrounds the pericardium: the duct may be observed to run along the convex side of the rectum. The following is the description of this preparation in the original MS. Catalogue: "A Snail; shell taken off; air-bag opened; membrane exposed, covering part of viscera and genitals, some coils of which are seen through it; on the right is the last gut, as if a continuation of the spiral turns; and in the semicircular direction is the duct of that gland running in the doubling of the air-bag. This, I believe, is kidney; its mucus is like that of Birds; its opening is near the anus, and accompanies the rectum." The researches of Professor Jacobson have shown that the secretion of this gland contains urea.

b. *Where in pairs.*

1177. The body of a Lump-fish (*Cyclopterus Lumpus*, LINN.), with the abdomen exposed to show the kidneys *in situ*. They commence by enlarged portions on either side the spine at the anterior boundary of the abdomen, diminish as they extend backwards, and soon unite on the mesial plane, where the apparently single gland is continued, gradually decreasing in size, to the posterior end of the abdomen. There is in this fish a distinct urinary bladder, bifid at the anterior extremity, and situated behind or dorsad of the rectum. The urethra opens upon a projecting penis, through which two bristles are passed, one into the urinary bladder, the other into the common duct of the testes.

1178. The body of the Nuss, or spotted Dog-fish (*Scyllium Canicula*, Cuv.), with the abdomen laid open and viscera removed to show the kidneys: they are distinct symmetrical glands, commencing by very narrow strips, and, contrariwise to the Lump-fish, increasing as they extend backwards to the posterior end of the abdomen.

1179. The posterior moiety of a Siren (*Siren lacertina*, Linn.). The kidneys are two oval flattened bodies, confined to the posterior part of the abdomen, and having an entire investment of peritoneum. The allantoid, or urinary bladder, is of an elongated narrow figure, situated in front or sternad of the rectum, and opening into it: a bristle is placed in it.

1180. The posterior part of the trunk of a Frog (*Rana temporaria*, Linn.), with the abdomen exposed to show the kidneys, injected, *in situ*: they are lodged at the back part and lower end of the cavity, being in contact with the divided urinary bladder.

1181. The posterior part of a Serpent (*Coluber*), with the ventral parietes of the abdomen removed to show the kidneys *in situ*: they are elongated lobulated glands, and the left is situated about one fourth its length nearer the anus than the right. There is no urinary bladder.

1182. A section of the posterior part of the trunk of a small Crocodile (*Crocodilus acutus*, Cuv.), showing the kidneys, injected, *in situ*. The cellular and peritoneal coverings have been removed from the left kidney, showing its lobulated and convoluted figure; they are left on the opposite one, in front of which the right oviduct is preserved, with a bristle passed along it. Another bristle is inserted into the left oviduct, and the long one into the corresponding ureter. The rectum and vestibular cavity are laid open, showing the distinct compartment in which the ureters terminate.

1183. A young Turtle (*Chelonia Mydas*, Brogn.), with the plastron or sternum removed to show the kidneys, which are injected: they are lodged at the back of the posterior extremity of the abdomen, and are of a flattened lobulated form. Anterior to the rectum there is a small allantoid, or urinary bladder, into which, however, the ureters do not immediately open. See No. 753.

1183 a. The posterior part of the body of a Cuckoo (*Cuculus canorus*, Linn.), with the ventral parietes of the abdomen removed to show the kidneys *in situ*. These are placed, as in the cold-blooded Ovipara, low down in the abdomen: they are each divided into three lobes, which are lodged in the depressions of the sacral and iliac bones. Besides the above parts, the testes are seen on the ventral surface of the anterior lobes of the kidneys, the left being the largest. The membrane covering the lungs, and the small diaphragmatic muscles inserted therein to determine its tension, are also well displayed. *Mus. Jennerianum.*

1184. A Mole (*Talpa Europæa*, Linn.), with the abdomen laid open to show the kidneys, which here, as in other Mammalia, are situated towards the upper or anterior part of the abdomen, at a distance from the pelvis. The right kidney, as in most quadrupeds, is nearer the diaphragm than the left.

2. *Parenchyma homogeneous; Renal Ducts arborescent, immediately continuous with the Ureter.*

1185. A section of the trunk of a Sturgeon (*Acipenser Sturio*, Linn.), showing the elongated kidneys. The ureters extend along the anterior surface of the glands receiving the smaller ramifications of the ducts, and terminate close together in the cloaca: a red bougie is passed into the left ureter.

1186. The anterior enlarged extremities of the kidneys of a Lump-fish, minutely injected, and a longitudinal section removed to show the uniformity of texture throughout the gland. On the cut surface the vein may be observed laid open, which distributes branches through the gland for the secretion of the urine from venous blood.

1187. One of the kidneys of the 'Devil-fish,' from which a section has been removed to show the duct continued through it in a serpentine form and receiving numerous branches as it passes along.

1188. The kidneys of a Frog, injected, showing the numerous branches sent off to them from the aorta. One of the fatty appendages is preserved.

1189. The kidneys, ureters, oviducts, and cloaca of an Alligator (*Crocodilus Lucius*, Cuv.). The kidneys have been stripped of their capsules and unravelled to show the brain-like disposition of the flattened lobules. A bristle is placed in the ureters, which terminate in the circumscribed space below the valve of the rectum. A quill is placed in the right oviduct, and bristles are inserted into the glandular pouches which open into the vestibule.

1190. The kidney of an Alligator dissected, and its convoluted lobules unravelled, showing many of the superficial branches of the ureters filled with the white secretion of the gland, which soon assumes a semifluid consistence from the preponderance of the saline constituents of the urine, viz. the uric acid, muriate of ammonia, and phosphate of lime.

1191. A portion of the kidney of an Alligator, injected, by the arteries.

1192. A section of the kidney of a Tortoise (*Testudo radiata*, Linn.). It shows the convolutions of the glandular substance and its uniform vascularity, being minutely injected.

1193. The opposite section of the same kidney.

1194. The kidney, minutely injected, of the East Indian Tortoise (*Testudo Indica*, Vosm.).

1195. The kidneys of an Ostrich (*Struthio Camelus*, Linn.). They are of an elongated flattened form and lobulated, but the divisions do not extend so deeply into the glandular substance as in most other birds; the anterior lobe, which is the largest, is however completely separated from the rest. The substance of the different lobes has a convoluted disposition like that of the reptiles, but is more compact. The renal arteries sent off from the aorta are shown on one side, and the corresponding veins joining the inferior cava on the opposite, where also the testes and supra-renal glands may be observed: bristles are placed in the ureters.

1196. The kidneys of a Turkey (*Meleagris Gallo-pavo*, Linn.). A longitudinal section has been removed from one of these, showing the uniformity of the glandular substance, and the complete separation of the lobes of the kidney. White masses of the urinary salts may be observed in the ureters, which run down the anterior part of the kidneys.

1197. The left kidney of the Pelican (*Pelecanus Onocrotalus*, Linn.). It is only partially subdivided, and the lowest lobe is the largest: its principal artery is a branch of the femoral. The ovary and supra-renal gland are here preserved; the latter is laid open by a longitudinal section, showing it to be composed, like the kidney, of a homogeneous compact substance.

3. *Parenchyma of two kinds; Renal Ducts fasciculate, terminating in a reservoir, called 'Pelvis.'*

A. *Renal Vessels.*

1198. The kidney of a fœtal Foal injected and macerated, after the removal of the capsule, to show the minute tortuous secerning arteries of the cortical substance.

1199. A similar specimen.

1199 A. The kidney of a fœtal Calf, similarly prepared.

Presented by Wm. Lawrence, Esq., F.R.S.

1200. The kidney of a common Cat (*Felis domestica*, Brisson), in which the superficial veins have been filled with red injection, showing their arborescent distribution.

1201. The kidney of a feline animal, called in the MS. Catalogue the 'East-India Tiger-cat,' with the superficial veins injected. They emerge from the cortical substance principally on the convex side of the gland, where they form a network by their anastomoses.

1202. The kidney of a Leopard (*Felis Leopardus*, Schrebers), with the veins injected.

1202 A. The kidney of a Serval (*Felis Serval*, SCHREBERS), in which the arteries are filled with white injection and the veins with red, the superficial ramifications of which are thus rendered beautifully distinct.

Prepared by Mr. Clift.

1203. The kidney of the Tiger (*Felis Tigris*, LINN.), in which the veins are filled with yellow injection, showing their superficial branches situated in the substance of, rather than upon, the capsule.

1204. The kidney of a Lion (*Felis Leo*, LINN.), with the veins filled with dark-coloured injection, and the large trunks preserved to show the relative proportion of the superficial to the deep-seated veins. The capsule has been partially removed to show the minute veins emerging from the cortical substance.

1205. The kidney of a Lion, with the veins injected and the capsule left on to show its outer layers covering the superficial veins, which are consequently less prominent than in the Cat.

1206. The kidney of a Hyæna (*Hyæna striata*, ZIMM.) injected, and showing the superficial veins in the same proportion and with the same distribution as in the Lion.

1206 A. The kidney of a Suricate (*Ryzæna tetradactyla*, ILLIG.), with the veins injected with quicksilver, a similar proportion of which ramify in an arborescent manner upon the surface of the gland.

Prepared by Mr. Owen.

1207. The kidney of a Seal (*Phoca vitulina*, LINN.), with the veins injected with size and vermilion, showing the greater part of them distributed in a reticulate manner upon the surface.

B. *Renal Ducts.*

a. *Tubuli uriniferi terminating on a concave surface in the pelvis.*

1208. A section of the kidney of an Ass (*Equus Asinus*, LINN.), with the *tubuli uriniferi* partially injected from the pelvis with size and vermilion; a process which is readily effected in this division of kidneys, in consequence of the mode of termination of the tubuli within the pelvis. This cavity is here shown to be of a triangular form, the ureter being continued from one angle, while the other two extend for some distance towards the upper and lower extremities of the kidneys in the form of canals, into which the tubuli open by conspicuous orifices.

1209. A section of the kidney of a Horse (*Equus Caballus*, Linn.), including one of the pelvic canals, which is laid open to show the terminal orifices of the tubuli uriniferi; these are partially filled with size and vermilion.

1210. Another section of the kidney of a Horse, with the tubuli uriniferi similarly injected, showing these minute vessels uniting to form larger canals as they approach the pelvis.

1211. A small portion of the kidney of a Horse, with the terminal trunks of the tubuli uriniferi filled with red injection.

1212. A section of the kidney of a Horse, with the tubuli uriniferi successfully filled with a white injection, which in some parts has penetrated so far as to show the tubuli extending through the cortical substance to the surface of the gland.

1213. A portion of the same kidney, which has been torn off in the direction of the tubuli, showing their form, extent, and union, as they approach the pelvic cavity. They apparently commence by blind extremities at the surface of the kidney, are abundantly surrounded by the minute secerning arteries and veins in the cortical part of the gland, but constitute almost exclusively the medullary substance.

1214. A transverse slice of the same kidney, in which the diameters of the tubuli uriniferi are well shown.

1215. A section of the kidney of a Zebra, showing the form of the pelvis, and the tubuli uriniferi partially filled with white injection. The canals continued from the pelvis towards the ends of the kidney are proportionately shorter than in the Horse, but the structure of the entire gland is essentially the same. A few small arteries penetrate the convex surface of the kidney.

1216. A small portion of the opposite kidney of the same animal, with the tubuli partially filled with dark-coloured injection.

1217. A section of the kidney of a Tapir (*Tapir Americanus*, Linn.), with the arteries injected, and the pelvis laid open to show the terminations of the tubuli uriniferi, as in the Horse. A bristle is placed in the beginning of the ureter.

b. *Tubuli uriniferi terminating on one conical projection, or mammilla.*

1218. The kidney of a Lion uninjected, divided longitudinally from the convex side to the insertion of the vessels, and showing the cortical and medullary portions of the parenchyma, and the single mammilla by which the greater part of the tubuli terminate in the pelvis.

1219. A transverse section of the kidney of a Lion, with the arteries injected, showing the concave surfaces at the base of the mammilla on which the lateral tubuli terminate: the projection of the mammilla is also well displayed by this method.

1220. A longitudinal section of the kidney of a Lion, with the veins injected, showing the deep-seated branches of the latter running in the interval of the cortical and medullary parts: the latter is of a remarkably close compact structure. The supra-renal gland is left attached to the vein, and is laid open to show its structure, which is made up, like the kidney, of two kinds of substances, differing in colour.

1221. A similar section of the kidney of the East India Tiger-cat, showing the compacted tubuli terminating in a well marked mammilla: a bristle is passed through the ureter.

1222. The kidney of a Raccoon (*Procyon Lotor*, Storr), minutely injected by the arteries, showing its simple conglobate form, as contradistinguished from the same organ in the Bear, with which the Raccoon is generically related in the Linnean system; the vascularity of the cortical substance, and the form of the mammilla in which the medullary part terminates, are also well displayed in this preparation.

1223. The kidneys of the East India Skunk (*Mydaus Meliceps*, Horsfield). They are divided longitudinally as far as the pelvis, into which the urine passes by a pointed mammilla. The upper kidney is injected, which shows the relative proportions of the cortical and medullary substances. The continuation of the tubuli to the surface of the gland gives a fibrous appearance to the cortical part.

1224. The kidney of a Mole (*Talpa Europæa*, Linn.) injected, and longitudinally divided. The uninjected tubuli may be plainly seen extending through the cortical substance, as is shown in the injections of the kidney of the Horse.

1225. The kidneys of a Jerboa (*Dipus Sagitta*, Gmel.). The upper one is laid open to show the remarkably elongated and pointed mammilla.

1226. A longitudinal section of the kidney of the Cape Mole (*Bathyergus Capensis*, Illig.), showing a similarly elongated mammilla.

1227. The kidneys of an Opossum (*Didelphys brachyura*, Pall.). A section has been removed from the upper one to show the elongated mammilla, which is continued beyond the pelvis into the ureter. In the lower specimen it is seen projecting from the gland.

1228. The kidney of a young Kangaroo (*Macropus major*, Shaw). It has been partially injected, and longitudinally divided to show the small extent of the cortical substance and the large mammilla.

1229. The kidney of a Monkey, dissected to show the formation of the mammilla by the convergence of several fasciculi of the tubuli uriniferi. The gland is minutely injected by the arteries.

1230. A longitudinal section of the kidney of a Monkey, minutely injected by the arteries, showing the large proportion which the cortical bears to the medullary part.

1231. The kidney of a Monkey injected by the arteries, but not too forcibly, by which means the distribution of their minute ramifications may be more readily distinguished.

1232. A thin slice of a similarly injected kidney, dried, and preserved in oil of turpentine, showing the tortuosity of the minute ramifications of the arteries.

1233. A longitudinal section of the kidney of a Gibbon (*Hylobates Lar*, Illig.), injected by the veins, showing the relative proportions of the cortical and medullary substances, and the form of the mammilla in which the tubuli terminate.

1234. A section of the kidney of a Monkey, minutely injected by both arteries and veins.

1235. A section of the kidney of a Monkey, in which the arteries are injected red, and the tubuli successfully filled with white injection, which shows that they extend through the cortical substance to the surface of the gland, and unite as they approach the pelvis, in the same manner as is displayed in the successful injections of the kidneys of the solipedous quadrupeds.

c. *Tubuli uriniferi terminating on a ridge.*

1236. The kidney of a Dog (*Canis familiaris*, LINN.). The single mammilla here assumes an elongated form like a ridge, formed by the union of lateral fasciculi.

1237. The kidney of a Nylghau (*Antilope picta*, PALL.). It is minutely injected, and a portion of the glandular substance removed from the concave side to show the lateral processes and elongated ridge upon which the tubuli terminate. Some projecting portions, like rudiments of distinct mammillæ, may be seen on this ridge.

1238. The mammillary ridge, with portions of the lateral fasciculi of tubuli uriniferi of the kidney of a Dromedary (*Camelus Dromedarius*, LINN.).

1239. The whole of the medullary or tubular part of the opposite kidney of the same Dromedary. The cortical or vascular part of the gland is stated to have been destroyed by putrefaction.

1240. A longitudinal section of the kidney of a Dromedary, the arteries filled with red, and the veins with black injection.

1240 A. The kidney of a young Dugong (*Halicore Indicus*, CUV.) laid open from the concave side to show the numerous lateral processes upon which the tubuli terminate. The exterior of the kidney is smooth, and the ureter commences from a single pelvis. *Prepared by Mr. Clift.*

d. *Tubuli uriniferi terminating on several mammillæ.*

1241. A human kidney injected, and laid open longitudinally to show the medullary structure divided into several distinct conical fasciculi of tubuli uriniferi.

1242. A longitudinal section of the human kidney, with the pelvis preserved entire, and distended to show the processes called calyces or infundibula, which receive the urine excreted by the different mammillæ.

1242 A. Two portions of human kidney, each including a conical group of tubuli uriniferi and its terminal mammilla, showing how the latter is surrounded by the infundibular process of the pelvic membrane or calyx. The capsule of the kidney is partially reflected from the upper portion.

Presented by Sir Wm. Blizard, F.R.S.

1243. A portion of human kidney minutely injected.

1244. A thin transverse section of the cortical substance of the human kidney, minutely injected.

1245. A longitudinal section of the same.

1246. A similar section, including one of the cones formed by the converging tubuli uriniferi.

1247. A thin slice of a human kidney minutely injected, dried, and preserved in oil of turpentine.

1248. A thin transverse slice of a human kidney similarly prepared.

1249. A similar preparation.

1250. A smaller portion more minutely injected, similarly preserved.

1251. A similar preparation.

These are favourably prepared for microscopical examination.

1252. The kidney of an Ox (*Bos Taurus*, LINN.) minutely injected, and a section removed to show the ramifications of the pelvis, or elongated infundibula. The cortical substance presents externally a number of clefts extending inwards to a varying depth, and in some degree corresponding to the separate cones of tubuli uriniferi within; this gives a lobulated structure to the gland, which is permanent. A similar structure is observable in the human kidney at an early period of existence, but the clefts are afterwards obliterated by a continued development of the cortical substance.

1253. One of the lobes of the preceding kidney, showing the depth of the dividing cleft, and the terminal mammilla of the tubular substance, in the centre of which there is a depression.

1254. A similar specimen.

1255. A smaller lobe of the same kidney, on one side of which the cortical substance is rent, to show the minute tortuous secerning vessels.

1256. A section of the kidney of an Ox, showing three mammillæ converging to terminate apparently in one infundibulum.

1257. A section of a kidney, including a mammilla and an elongated infundibulum, in which an injection of the tubuli has been attempted from the infundibulum, and has penetrated for a small extent.

1258. A longitudinal section of the kidney of a Bison (*Bos Bison*, Linn.), showing the numerous medullary cones and the ramifications of the pelvis, which extend into the substance of the kidney to surround the mammillæ and receive the urinary secretion. The cortical substance is thinner than in the Ox, and the kidney shorter and broader.

e. *Kidney subdivided into distinct lobes, or renules.*

1259. The kidney of a Bear (*Ursus Arctos*, Linn.) injected. The lobes or renules are separated from each other by the removal of the delicate capsule and intervening cellular tissue, and they are then seen to be suspended from the trunks of the vessels and excretory duct like a bunch of grapes.

1260. One of the lobes or renules of the preceding kidney divided to show the cortical and medullary substances, the mammilla, and infundibular process of the ureter, the whole representing a kidney of the simple structure displayed in *Section* b.

1260 a. The kidney injected of the Labiated Bear (*Ursus labiatus*, Blainv.).

The renules are separated to show the principal branches of the ureter, and some of them are laid open to show the two mammillæ and corresponding cones of tubuli which they contain. *Prepared by Mr. Owen.*

1261. The kidney of the American Black Bear (*Ursus Americanus*, Pallas). The capsule and connecting cellular substance have been removed on one side, but are left on the opposite.

1262. The kidney of the Polar Bear (*Ursus maritimus*, Linn.), with the capsule removed and the renules partially separated.

1263. The kidney of a fœtal Seal (*Phoca*?), with the capsule removed to show the numerous small renules of which it is composed.

1264. The kidneys of a fœtal Walruss (*Trichecus Rosmarus*, Linn.): from one of these the capsule is removed, on the other it is left entire.

1265. The left kidney of a young Walruss injected, and the capsule removed to show its component renules, which are upwards of four hundred in number*. Their complete separation from each other is shown by the circumstance that where the artery in any of them has been obstructed they remain uninjected, in consequence of the absence of anastomoses between their vessels and those of contiguous renules.

1266. The right kidney of a young Porpesse (*Phocæna communis*, Cuv.) injected, and with the capsule removed to show the component renules. It is of a flattened form, and the vessels may be observed to penetrate the gland at the opposite extremity to that at which the excretory duct emerges.

1267. A transverse section of the kidney of the Piked Whale (*Balæna Boops*, Linn.).

1268. A longitudinal section of the kidney of the same Whale. Both preparations are minutely dissected, and well illustrate Mr. Hunter's description.

"The kidneys in the whole of this tribe of animals (*Cetacea*) are conglomerated, being made up of smaller parts, which are only connected by cellular membrane, blood-vessels, and ducts, or infundibula, but not partially connected by continuity of substance, as in the human body, the Ox, &c. Every portion is of a conical figure, whose apex is placed towards the centre of the kidney, the base making the external surface; and each is composed of a cortical and tubular substance, the tubular terminating in the apex, which apex makes the mammilla. Each mammilla has an infundibulum, which is long, and at its beginning wide, embracing the base of the mammilla, and becoming smaller. These infundibula unite at last, and form the ureter. The whole kidney is an oblong flat body, broader and thicker at the upper end than the lower, and has the appearance of being made up of different parts placed close together, almost like the pavement of a street.

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* See Appendix to 'Parry's Voyage,' p. 340.

"The ureter comes out at the lower end and passes along to the bladder, which it enters very near the urethra.

"The bladder is oblong, and small for the size of the animal. In the female the urethra passes along to the external sulcus or vulva, and opens just under the clitoris, much as in the human subject.

"Whether being inhabitants of the water makes such a construction of kidney necessary, I cannot say; yet one must suppose it to have some connexion with such situation, since we find it almost uniformly take place in animals inhabiting the water, whether wholly, as this tribe, or occasionally, as the Manatee, Seal, and White Bear: there is, however, the same structure in the Black Bear, which, I believe, never inhabits the water. This, perhaps, should be considered in another light, as nature keeping up to a certain uniformity in the structure of similar animals; for the Black Bear in construction of parts is, in every other respect as well as this, like the White Bear."

On Whales, Phil. Trans., vol. lxxvii. p. 412.

SERIES II. Ureter and Urinary Bladder.

1269. A portion of a Lump-fish (*Lepadogaster Dentex*, SCHNEIDER), showing the urinary bladder, which is of a thin membranous structure. A bristle is passed into it by the urethra, which terminates at the extremity of the projecting penis.

1270. A Frog (*Rana temporaria*, Linn.), with the ventral parietes of the abdomen removed to show the bifid urinary bladder. This is of a thin membranous structure, as in the preceding example, and of considerable size. There is reason to suppose that besides serving as a receptacle for urine, it acts also as an aquatic respiratory organ, receiving water from without, which affects the blood that is distributed over the parietes of the bladder.

1271. The Zebra Tortoise (*Emys ornata*, Gray), with the plastron removed to show the bifid urinary bladder.

1272. The left kidney, with the rectum, urinary bladder, urethro-sexual canal, and ureters of a Turtle (*Chelonia Mydas*, Brongn.). The bladder is laid open, showing its thick muscular parietes and corrugated internal surface when in the contracted state; but the circumstance of most interest in this preparation is the termination of the ureters, which do not enter the bladder, but open by projecting papillæ at some distance below the constriction which seems to form the neck of the bladder, into which therefore the urine must pass by regurgitation, if it be ever retained in that receptacle.

1273. The termination of the rectum and the cloaca of a Crocodile (*Crocodilus acutus*, Cuv.). The intestine is laid open, and large bristles are placed in the ureters to show them terminating below the valvular part of the rectum.

1274. The termination of the rectum, urinary bladder, and cloaca of an Ostrich (*Struthio Camelus*, Linn.). The round aperture by which the rectum communicates with the dilated receptacle of urine is left entire. Bristles are inserted in the ureters.

1275. A portion of the neck of the bladder, with the terminations of the ureters of a Dolphin (*Delphinus Tursio*, Fabr.), showing the extent to which the ureters run obliquely between the coats of the bladder, and the semilunar fold which covers their terminal apertures.

1276. A small portion of the human urinary bladder, injected. The decussating fibres of the muscular coat are shown on one side, and the vascular lining membrane on the opposite.

Series III. Supra-renal Glands.

1277. The supra-renal gland of a Tortoise (*Testudo græca*, Linn.). Its external surface presents a convoluted appearance analogous to that of the kidney; and the internal structure exhibits in section a similar uniformity throughout.

1278. The other supra-renal gland of the same Tortoise, in which a more superficial section displays the convoluted disposition of the homogeneous parenchyma.

1279. The kidneys and supra-renal glands of the Two-toed Sloth (*Bradypus didactylus*, Linn.). A section has been taken from those of the right side, showing that both are composed of two substances, a cortical and medullary, that of the kidney terminating in a single mammilla. The size of the supra-renal gland exceeds that of the kidney.

1280. The kidney and supra-renal gland of the Restless Cavy, or Guinea-pig (*Cavia Porcellus*, Erxl.): both are laid open, to show the different substances of which each is composed.

1281. A longitudinal section of the kidney and supra-renal gland of apparently some large Rodent animal, showing the different substances of which each is composed.

1282. The kidney and supra-renal gland of the Spotted Cavy (*Cœlogenys subniger*, Cuv.), showing their similarity of form.

1283. One of the lobes of the kidney, and the supra-renal gland of a Bear (*Ursus Arctos*, Linn.).

1284. A section of the supra-renal gland of a Tiger (*Felis Tigris*, Linn.).

1285. The supra-renal gland of a Horse, laid open to show the two substances.

1286. The supra-renal gland of a Tapir (*Tapir Americanus*, Gmel.) similarly divided, and showing very distinctly the central dark-coloured substance.

1287. A section of the supra-renal gland of an Elephant (*Elephas Indicus*, Cuv.). It is bilobed at the greater extremity. The two substances are readily distinguishable.

1288. The supra-renal gland of some large quadruped, from which a section has been removed to show its structure.

1289. The supra-renal gland of the same animal.

1290. The supra-renal gland of a Dolphin (*Delphinus Tursio*, Fabr.).

1291. The kidney and supra-renal gland of a Porpesse (*Phocæna communis*, Cuv.). This preparation shows the close analogy which subsists between the two bodies in their lobulated exterior; but the section of the supra-renal gland exhibits its compact structure.

Fig 2

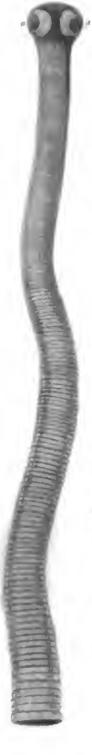

Fig 3

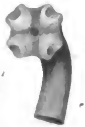

Fig 1

Fig 7

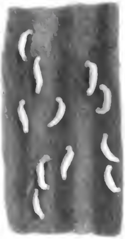

Fig 10

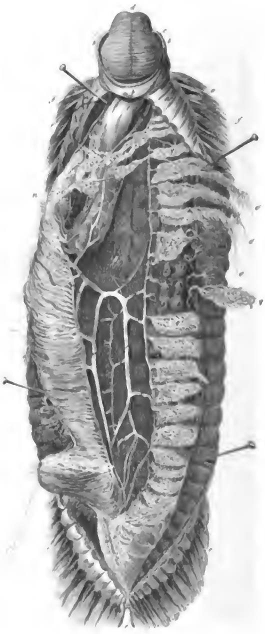

Fig 8

Fig 9

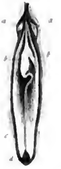

Fig.

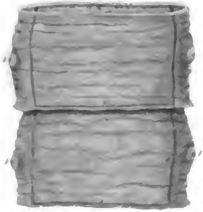

Fig 6

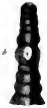

Fig 4

DESCRIPTION OF THE PLATES.

The subjects contained in Plate XIV. are illustrative of the first stages in the development of the Vascular System. In the Parenchymatous Entozoa (figg. 1. to 9.) the nutritious fluid is propelled along canals which combine the functions of digestive, absorbent, and distributive or arterial tubes. These canals have not distinct parietes, but are excavated, as it were, in the parenchyma of the body, the contractions of which serve to propel the fluids through the system without the necessity of any organ specially formed for that purpose. This structure accords with the earliest observed condition of the circulating system in the embryo of the Fowl. In the figure of the Red-blooded Worm (fig. 10.) Mr. Hunter has shown the vascular system, superadded to the digestive canal, and both separated from the parietes of the body. The coats of the vessels, aided by the contractions of the muscular case in which they are contained, suffice also here for the motions of the blood, and consequently a distinct heart is not developed.

Figures 1. to 6.* are parts of a Tape-worm (*Tænia denticulata*, Rud.), of which the following is the original description in the MS. Catalogue: "These are six figures of Tape-worm from an Ox. Figures 1. and 4. are of the natural size; the other figures are the same magnified. This worm had the openings into each joint on the edges, and there was but one of them on each side of each joint. The head was of a peculiar shape, and the joints near the head were so faint as hardly to be perceptible, but became so as they receded from the head.

" *Fig.* 2. is fig. 1. magnified, showing the openings or projections *a*, *a*, which appear to be hollow, and which may be supposed to be mouths, or suckers, or holders, as in the Cuttle-fish.

" *Fig.* 3. Is another view of fig. 2. which exposes the whole of these hollow projections, and which are four in number.

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* No. 69. *MS. Catalogue of Drawings.*

"*Fig*. 5. Are the two joints of fig 4. magnified, on the edges of which is seen a profile view of the openings *b*, *b*.

"*Fig*. 6. Is the edge of one of the joints of fig 5. opposite to which it stands, which gives a direct view of the openings *b*." These openings are the outlets of the genital tubes: *c*, *c*, are the longitudinal and transverse nutrient canals.

Fig. 7.* A portion of the intestine of an Eider Duck (*Anas mollissima*, Linn.), with several specimens of *Echinorhynchus filicollis*, Rud., adhering to it. This species of intestinal worm is described by Dr. Solander as a species of Sipunculus, as follows: "*Sipunculus lendix, corpore nudo cylindraceo, aperturâ subterminali.* Found adhering by its small snout to the inside of the intestines of an Eider Duck. Mr. Hunter, who, at my request, dissected it, informed me that he had seen the same species of animal adhering to the intestines of Whales." (*Phipps's Voyage towards the North Pole*, 4to, p. 194.) Rudolphi, believing the word species to have been used by Hunter in the Linnæan acceptation, observes, in his great work on the *Entozoa*, "Hunterus se eandem ac insequentem speciem (viz. Ech. An. moll.) in balænâ reperisse Phippsii narravit; hoc tamen vix admiseris, mammalium enim et avium vermes nunquam specie conveniunt." (*Entoz. Hist. Nat.* ii. Part i. p. 304.) Rudolphi, therefore, supposes the species infesting the Cetacea to which Mr. Hunter alluded to be identical with his *Echinorhynchus porrigens* (*Synopsis Entoz.*, p. 71.): it is, however, a much smaller worm, being nearly the same size as the *Echinorhynchus filicollis*, but perfectly distinct. It is described in the Catalogue of Invertebrata, under the term *Echinorhynchus glandiceps*, from the resemblance of its head to an acorn. See No. 191. *Nat. Hist.*

Fig. 8. A magnified view of *Echinorhynchus filicollis*.

Fig. 9. The same laid open, and showing principally the generative organs.
a, The lemnisci, or lateral glands. *b*, *b*, The testes. *c*, The vas deferens. *d*, The double cone containing the penis.

Fig. 10.† A specimen of Amphinome (*Amphinome capillata*, Brug.), laid open along the ventral aspect, and dissected to show the principal trunks of the vascular system and the internal branchial plexuses of the left side.

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* No. 70. *MS. Catalogue of Drawings.*

† No. 72. *Ibid.* This beautiful drawing has no description.

a, a, The ventral surface of the segments or rings of the body.
b, b, The circular fleshy lip surrounding the mouth.
c, c, The callous lining of the lip.
d, The proboscis, finely striated transversely.
e, e, The ventral oars, or packets of bristles.
f, f, The ventral cirri, or feelers.
g, The anal cirri.
h, The anus.
i, i, The bases of the ventral oars, with their surrounding muscles.
k, k, The bases of the dorsal oars, with their surrounding muscles.
l, The dorsal longitudinal muscular bands.
m, m, The ventral longitudinal muscular bands.
n, n, The ventral intestinal vein.
o, o, Branches continued from the intestinal vein to form the internal branchial plexuses.
o', o', The same vessels divided and turned aside.
p, p, Veins from the segments, assisting to form the branchial plexuses.
q, q, The internal branchial plexuses of the left side. *q',* One of these plexuses separated from the branchial vein and turned aside.
r, r, The lateral vessels which receive the blood from the branchial plexuses and external gills, analogous to branchial veins.
s, s, The trunks of the branchial veins conveying the aerated blood to the aorta without the intervention of a heart.
t, t, The dorsal vessel or aorta.
v, v, Branches which go to form the intestinal artery.
w, The intestinal artery.

The blood collected by the intestinal vein and by the veins of the segments of the body is distributed over the internal branchial plexuses and external gills, to be aerated: it is then received into the two lateral vessels *r, r,* from which it passes, by vessels analogous to branchial veins, to the aorta or dorsal artery; from this vessel the blood is propelled onwards to the intestine, the head, and the parietes of the body; and the returning veins *n*, *p*, complete the circulation.

Plates XV. to XVIII. are illustrations of the circulating system of the Lobster (*Astacus marinus*, Fabr.), of which the following are the original descriptions by Mr. Hunter.

Plate XV. "Is the heart and arterial system of a Lobster. Both figures are of the same Lobster, only cut through, to bring the whole into one plate. The shell is removed off the back, both of the body and of what is called the tail, which exposes a great number of parts.

"*a*, The stomach.

"*b*, *b*, *b*, *b*, The four lobes of the liver.

"*c*, *c*, The gills, or lungs.

"*d*, *d*, The beginning of the muscular part of the tail.

"*e*, *e*, The testicles.

"*f*, *f*, The ducts, or vasa deferentia.

"*g*, The heart.

"*h*, *h*, Two orifices of the veins entering the heart.

"*i*, *i*, Two arteries going to the anterior or upper parts, such as the anterior lobes of the liver, stomach, head, &c.

"*k*, *k*, The artery arising from the lower or posterior end of the heart, which, from its course, might be called aorta descendens (superior abdominal artery), giving off laterally, as it passes along, branches in pairs at each joint of the tail, to the muscles, &c., of the tail, and which is continued into fig. 2. lying on the gut, and dividing at the lower part into two branches, between which is seen *x*, the cæcum.

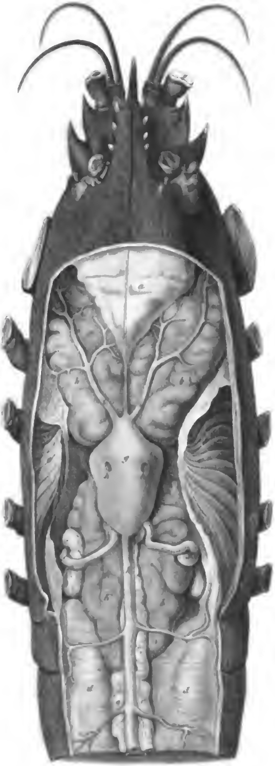
"*l*, The ophthalmic artery. *m*, *m*, The caudal arteries."

Plate XVI. *Fig.* 1. "A side view of the arterial system in the Lobster, where the arteries in Plate XV. are seen; as also the deeper seated vessels going to the under surface or fore part. Nearly one half of the body is removed to expose the deeper seated vessels.

"*a*, The stomach, which has one half removed, so as to show the cavity of that viscus.

"*b*, *b*, *b*, The intestine, which is one straight gut.

"*c*, *c*, *c*, The lobes of the liver of the left side, the right being removed.


a
b
b
d
d

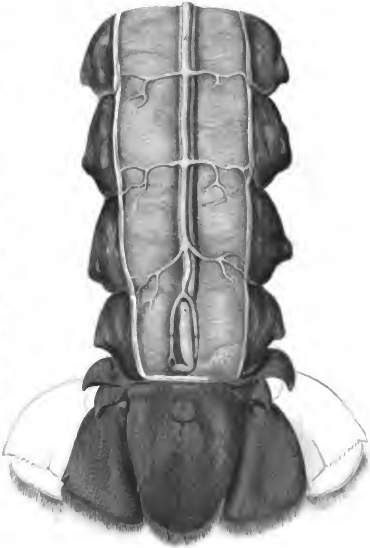


Fig. 1

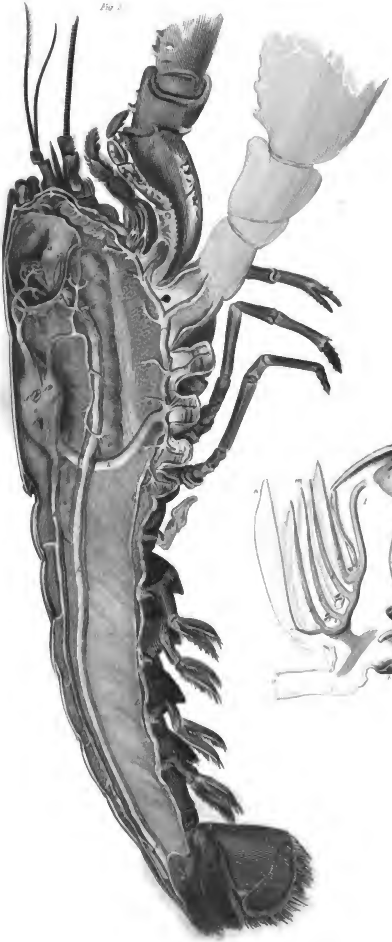
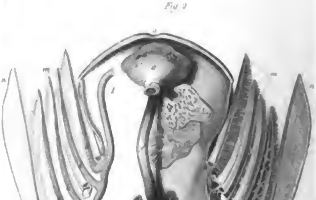


Fig. 2



" *d*, The hepatic duct of the right lobe entering the gut.

" *e*, The heart.

" *f*, *f*, *f*, Three orifices of three veins passing into the heart.

" *g*, The anterior (or antennal) arteries, described in Plate XV. *i*, *i*.

" *h*, *h*, The posterior or superior caudal artery, also described in Plate XV. *k*.

" *i*, An artery passing down between the two lobes of the liver, and sending arteries to each lobe (the hepatic artery).

" *k*, A large artery going down from the posterior end of the heart, principally supplying the feet and lungs or gills (sternal artery).

" *l*, Is a small artery passing back along the under surface of the tail, and lost in the muscles of that part (inferior caudal artery).

" *m*, Is the trunk of the artery *k*, bent forwards along the fore part of the thorax, giving off branches on each side to the feet and gills.

" *n*, *n*, *n*, The arteries going off to the feet.

" *o*, *o*, *o*, The branchial or pulmonary arteries.

" *Fig.* 2.* Is a transverse section of the body of the Lobster just behind the heart, which shows the course of the last-mentioned artery *k* in fig 1. The right half is finished; the left only in outline.

" *a*, The cut edge of the shell of the back.

" *b*, The under surface, or what might be called the breast or sternum.

" *c*, The posterior end of the heart.

" *d*, *d*, Two orifices of veins entering the heart.

" *e*, The cut end of the large artery (superior caudal) going along the gut to the tail.

" *f*, The trunk of the large artery (sternal) going to the legs and gills *k* in fig. 1.

" *g*, Is the trunk of an artery going to supply one tier of gills.

" *h*, *h*, *h*, The branches going to each gill.

" *i*, *i*, The artery to the leg.

" *k*, *k*, The internal vessels or veins from each gill.

" *l*, The common trunk, or branchial vein.

" *m*, *m*, The gills.

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* No. 78. *MS. Catalogue of Drawings.*

" *n*, *n*, The branchial laminæ subservient to the movement and renewal of the respiratory currents.

" *o*, *o*, The base of the feet.

PLATE XVII.*

"OF THE VEINS IN THE LOBSTER.

" The veins in this class of animals, as in the winged insect, &c., are principally in the form of large irregular cells, as if the cellular or investing membrane of the animal contained the venal blood: and when injected, we find the injection principally in large masses.

" *Fig*. 1. Exhibits the veins on the back or posterior side of the animal, the shell being removed; and as there is no fat, it requires no further dissection than simply removing the shell to see the superficial veins. In the same figure are seen some of the arteries above described in the Arterial System.

" *a*, A large mass of vein, lying chiefly on the stomach.

" *b*, Another mass similar to the above, lying principally on the heart, which might almost be considered an auricle, as from it are openings into the ventricle.

" *c*, *c*, *c*, &c., Are so many smaller masses of veins, which communicate with each other, and of course with the heart.

" *Fig*. 2. Is not finished."

There is no further description of this figure. It exhibits the superficial veins on the ventral or inferior side of the animal.

a, *a*, Bases of the external antennæ.

b, *b*, Internal antennæ.

c, *c*, External maxillary feet.

d, *d*, Bases of the chelæ, or great claws.

e, *e*, *e*, *e*, Bases of the remaining four thoracic feet of the left side.

f, One of the caudal or natatory feet.

g, *g*, The caudal laminæ.

h, The anus.

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* No. 79. *MS. Catalogue of Drawings.*

Fig. 1.

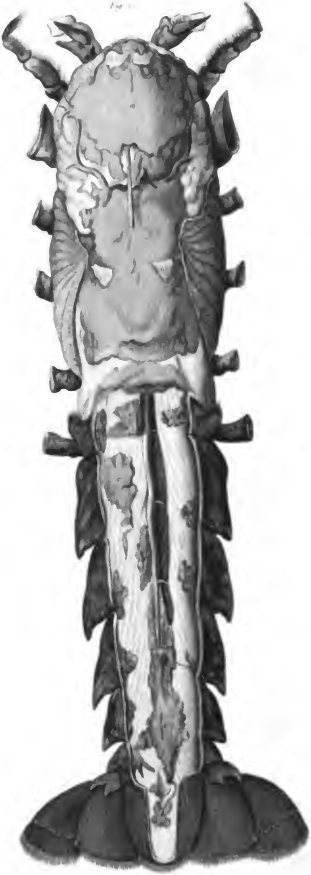
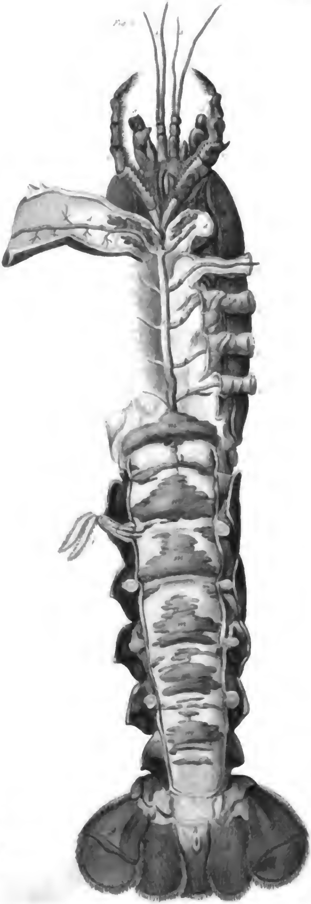


Fig. 2.



Pl. XIII

Fig. 1

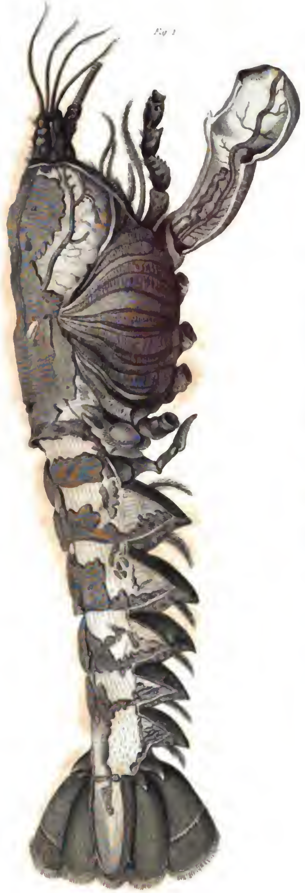
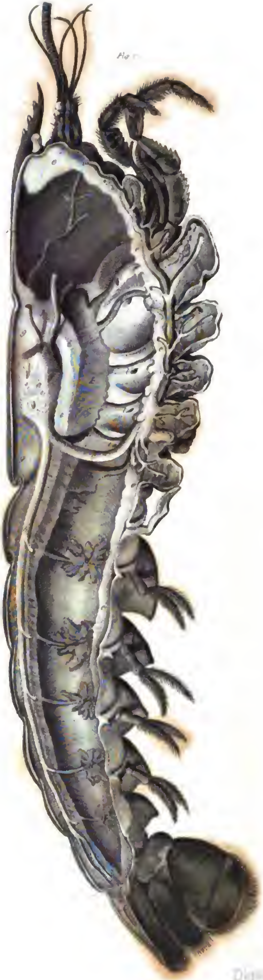


Fig. 2



i, The inferior abdominal or sternal artery.
k, *k*, Branches to the legs.
l, Analogous branch to one of the spurious feet.
m, *m*, Inferior superficial venous sinuses.

PLATE XVIII.*

" *Fig*. 1. A side view similar to Fig. 1. Plate XVII.

" *a*, Side view of the venous sinus covering the stomach.

" *b*, Side view of the sinus surrounding the heart. The letter is placed near one of the valvular orifices by which the venous blood is admitted to the ventricle.

" *c*, *c*, Superficial dorsal sinuses.

" *d*, *d*, Small masses of veins in the serrated part of the shell.

" *e*, Right antennal artery.

"*f*, *f*, Artery of the right chela.

" *g*, Corresponding vein.

" *Fig*. 2. Is a side view of the heart, arterial, and venal systems. The right half of the body is removed, which gives us a view of some of the deeper seated vessels.

" *a*, The heart.

" *b*, The artery going along with the gut to the tail, as before described. (Superior caudal artery.)

" *c*, The artery going to the gills and feet, also already described.

" *d*, *d*, *d*, *d*, &c., Are the veins on the side of the tail, now left attached to the shell, which before were left upon the muscles of the tail; and the shell removed, described in Fig. 1. *d*, *d*.

" *e*, *e*, *e*, &c., Is a pretty regular vein passing along about the middle of the tail, on the surface of the under shell: it runs along the thorax, or what I have called the sternum, (*b*, Fig. 2. Plate XVI.) along with the artery supplying the feet and gills; from thence it passes round the anterior end of the animal to the head, and opens into sinus *a*, fig. 1.

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* No. 80, 81. *MS. Catalogue of Drawings.*

"*f*, The cut edge of the sinus *a*, fig. 1, which shows how thin it is, although broad when seen on its posterior surface.

"*g*, *g*, Is the cut edge of sinus *b*, fig. 1.

"*h*, A communication between the sinuses *f*, *g*, and *i*, *i*, which is the cut edge of the union of a right and left sinus, the right being removed by this section, and the left remaining, which is represented by *k*.

"*l*, *l*, *l*, *l*, &c., Are small veins coming from the gills and entering the mass *k*, *k*."—*MS. Catalogue of Drawings.*

From the preceding figures and descriptions, it appears that both the blood from the general system and that from the respiratory organs are received into a large sinus or auricle surrounding the heart, into the cavity of which they pass by several orifices, and from which they are again propelled, so mixed, both to the general system and to the gills. But according to the recent observations and experiments of MM. Audouin and Milne Edwards *, the heart of the Crustaceans is a true systemic one, receiving only the aerated or pure arterial blood from the branchial veins, which terminate by two orifices in the sides of the ventricle; and these they assert to be the only venous orifices of the heart. If, however, the ventricle of a recent lobster be carefully opened on the abdominal surface, the orifices marked *h*, *h*, Plate XV., which the French anatomists state to be merely depressions, will be satisfactorily perceived to be true auricular inlets, guarded respectively by two semilunar valves, and giving passage to the blood from the pericardiac sinus. (See Prep. No. 898. A.)

The branchial vessels *o*, *o*, fig. 1. and *h*, *h*, fig. 2. Plate XVI., are regarded by the French anatomists as the nutritious arteries of the gills, the afferent vessels of the gills, or the true branchial arteries, being described as continued exclusively from the venous sinus marked *e*, *e*, fig. 2. Plate XVIII. The accuracy of this statement will be determined by a repetition of the experiments made on the living animal by MM. Audouin and Edwards; but the correctness of Mr. Hunter's account of the disposition of the venous system, of its termination in a pericardiac auricle, and of the communication of that general receptacle of the venous blood by several apertures with the ventricle, has been fully corroborated by the subsequent dissections of Lund † and Straus Durckheim ‡.

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* Mémoires pour servir à l'Hist. Nat. des Crustacés. 8vo, 1829.

† Isis, 1825.

‡ Considérations sur l'Anat. Comp. des Animaux articulés, p. 345.

Fig. 1.

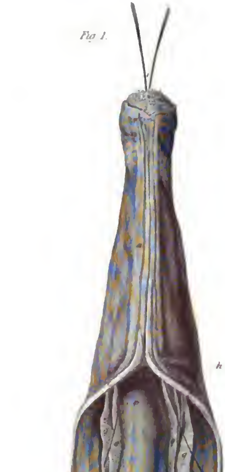
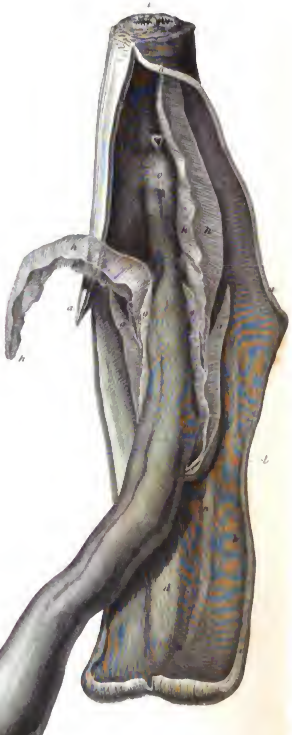


Fig. 2.



Wm Bell del

T. Brodie sc

PLATE XIX.*

Two figures of the animal or soft parts of a Razor Shell (*Solen Siliqua*, LINN.). They are represented with the anterior extremity downwards, which is the natural position of the Solen in the sand in which it burrows, the anal and branchial tubes projecting from the surface in order to maintain a communication with the sea water.

Fig. 1. *a,* The closed part of the mantle.

b, The open part of the mantle.

c, The fleshy margins of this part.

d, The back of the mantle, corresponding to the hinge of the shell.

e, The attached part or base of the foot.

f, The free and pendulous part of the foot.

g, The labial appendages: they are continued from either side the mouth, and probably serve both as organs of prehension, of selection, and of respiration, having an analogous structure to

h, The branchiæ (their commencement is only seen in this figure).

i, Bristles inserted into the branchial and anal orifices.

Fig. 2. The cylindrical portion of the mantle is laid open, exposing the branchiæ and the termination of the intestine. Letters *a* to *h* signify the same parts as in the preceding figure. *e* is placed on the bifurcated commencement of the foot. *h'* is the posterior extremity of the left branchia drawn out from the tubular part of the mantle after being detached from its connexion with its fellow.

k, k, The membranes which attach the gills to the sides of the base of the foot.

l, Points to the situation of the mouth, between the labial processes.

m, The anus.

n, The transverse fibres of the extended anterior adductor muscle, appearing through the thin lining membrane.

o, The posterior adductor.

A third drawing (No. 29. MS. Catalogue) shows principally the viscera, which are placed at and in the basis of the pendulous body or foot. The mouth, the liver, the stomach, the intestines, and the anus are severally indicated; but as this figure relates to another series of organs, and has already been given by Sir Everard Home in his Lectures on Comparative Anatomy (vol. ii. Pl. LXXXII. fig. 2.), it is thought unnecessary to repeat it here.

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* No. 28. *MS. Catalogue of Drawings.*

The branchiæ in this class of Mollusks are composed of highly vascular membranes supported by close-set parallel transverse filaments of a delicate horny texture; these are crossed at regular intervals by transverse lines or joints, and along either side of each supporting filament minute vibratile cilia are situated, which move rapidly in definite directions, and excite and maintain a perpetual current of sea water over the surfaces of the respiratory organs.

PLATE XX.

The circulating and respiratory organs of the Pearly Nautilus (*Nautilus Pompilius*, Linn.).

a, The great vein.

b, The orifices by which it communicates with the abdominal cavity.

c, The venous sinus.

d, *d*, The splanchnic veins from the liver, ovary, gizzard, &c.

e, *e*, What may be regarded as the origins of the branchial arteries, viz. where the blood begins again to move from trunks to branches.

f, *f*, The branchial arteries.

g, *g*, The follicles or reservoirs, appended to the branchial arteries: the orifices by which they communicate with the vessels are exposed on the left side (the parts being seen from the dorsal aspect).

h, The valve at the entry of the branchial artery into the gill, exposed in the right anterior vessel.

i, The cavity of the same artery, where it is imbedded in the muscular stem of the gill.

k, The corresponding trunk on the opposite side of the branchiæ, which receives the branchial veins.

l, *l*, The branchial veins.

m, The ventricle, or systemic heart, laid open.

n, The anterior or small aorta.

Pl. XV

Fig. 2.

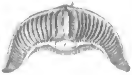
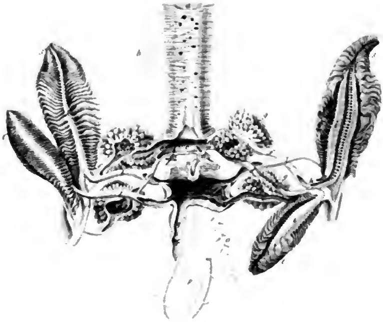
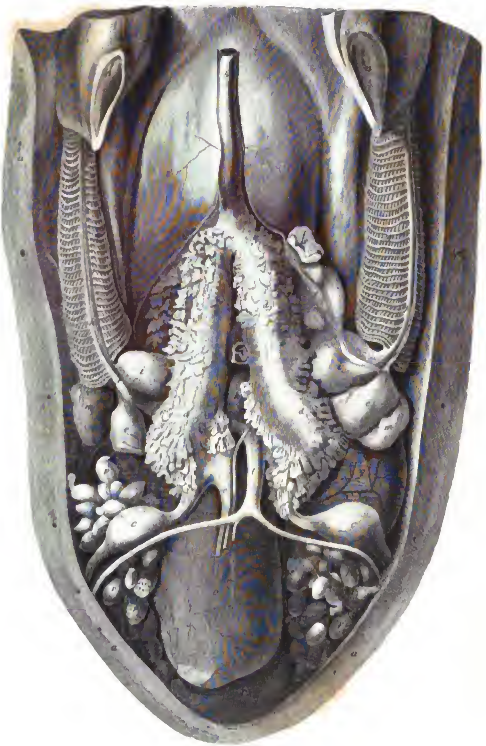


Fig. 1.



R. Owen del.

Zeitter sc.



o, The artery of the intestine.
p, The siphonic artery.
q, The continuation of the ventricle, forming the bulb of the large aorta.
r, The valve at the commencement of the artery.
s, The larger branchia of the right side, showing the arterial surface.
s′, The same of the left side, showing the venous surface.
t, The smaller branchia of the right side, showing the arterial surface, with *i*, the fleshy stem, entire, the dotted line indicating the passage of the branchial artery into it.
t′, The smaller branchia of the left side.

Fig. 2. A lamina of the larger branchia magnified, showing its subdivisions into the smaller laminæ. The letters indicate the same parts as in fig. 1.

This species of Cephalopod, being attached to a heavy shell, which affords it a complete defence, as in the univalve Mollusks, does not enjoy those active locomotive powers which characterize the higher or dibranchiate order. There is consequently a less amount of respiration required; the venous blood is continued into the gills, with the interposition only of the follicular auricles, and the lesser or branchial circulation is consequently unaided by the contractions of a ventricle.

PLATE XXI.

The circulating and respiratory organs, *in situ*, of the Cuttle-fish (*Sepia officinalis*, LINN.).

The following is the description of this drawing in the MS. Catalogue.

" *a*, *a*, The cut edges of the body, or shell, of the animal, where may be observed dark spots, which are the orifices of the cut arteries and veins.
" *b*, Vena cava anterior.
" *c*, Venæ cavæ inferiores.
" *d*, *d*, The two first, or pulmonary auricles.
" *e*, *e*, The two pulmonary (or branchial) ventricles.
" *f*, *f*, Ligamentous attachments, the artery going off underneath.
" *g*, *g*, The branchiæ.
" *h*, *h*, The branchial veins.
" *i*, *i*, The two common auricles, answering to the left auricle in Quadrupeds.

" *k*, The common ventricle.

" *l*, Inferior aorta."

Besides the above parts, the following are also well displayed in this figure:

m, *m*, The fleshy appendages to the branchial ventricles. These are probably rudiments of the smaller branchiæ of the Nautilus.

n, *n*, The smooth articular cavities at the base of the funnel, to which the lateral tubercles on the inner side of the mantle are adapted.

o, The stomach.

p, *p*, The ovisacs.

q, *q*, The ovarian glands.

r, The ink-bag.

s, The anus.

t, *t*, The cut edges of the membrane which separates the abdominal from the branchial cavity.

PLATE XXII.

" The circulating and respiratory organs of the above, taken out and dissected, giving a back view of the parts with the branchiæ turned different ways, to show the different vessels.

" *a*, The vena cava anterior.

" *b*, *b*, The lateral anterior venæ cavæ (receiving the veins of the fleshy mantle).

" *c*, *c*, The venæ cavæ laterales posteriores.

" *d*, The vena cava media posterior.

" *e*, *e*, The pulmonary (or branchial) auricles.

" *f*, *f*, The branchial ventricles. (*, *, Their fleshy appendages.)

" *g*, *g*, The branchial arteries. (*g′*, The fleshy stem in which it is lodged.)

" *h*, The branchial vein of the left side.

" *i*, *i*, The common auricles, answering to the left in Quadrupeds.

" *k*, *k*, The common (or systemic) ventricle.

" *l*, The superior aorta.

" *m*, The inferior aorta."

The irregular appendages, which give a spongy appearance to the branchial auricles (*e*, *e*), have a glandular structure, and exhibit vermicular motions in the living animal.

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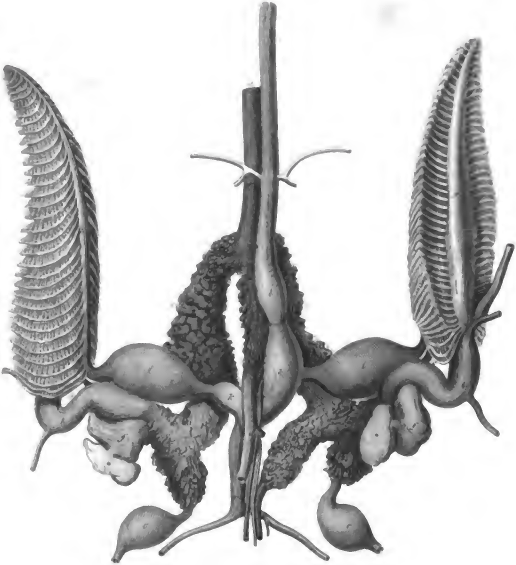

PLATES XXIII. AND XXIV.

Are illustrative of the circulating and respiratory organs of the Kattewagoe (*Menopoma Alleghaniensis*, Harlan), one of the Amphibious Reptiles without external gills.

The original description of these figures is prefaced by the following general observations on the *Perennibranchiata*, which Mr. Hunter aptly denominated "*Pneumobranchiata*."

" *General Observations on the Pneumobranchiata.*

" Different species of a new genus of animals have come of late years from South Carolina in America, to Europe, three of which I have seen, and it is probable there are many more.

" The first of them that came to Europe were brought to London in the year 1758 by Mr. Lake, who had resided many years in that province. I bought his whole collection of things, in which were two different species of this genus; and since that time I have got a third. Some time after Dr. Garden, of Charles Town, South Carolina, sent one of this species to the late Dr. Linnæus which he called the Siren.

" To the eye, two of them may pass as different species of the same genus, but the third might be supposed to belong to another, to which, however, it has but little connexion, being in its internal œconomy closely connected to the above two.

" This tribe of animals is widely different from all hitherto known. They are compounded of two grand divisions of the animal kingdom, yet not so as for all their parts to partake equally of both; for some parts incline more to the one of these divisions, other parts to the other, while a few are pretty distinctly made up of both, so as to be truly double, just as the parts of generation are in perfect Hermaphrodites, and these parts are the organs of respiration, to which the circulation must of course correspond. They hold with respect to respiration a middle rank between Fish, which breathe water, and those immediately above them, which breathe air, viz. those called Amphibia, and they are placed in this respect between the two, filling up the scale.

" The manner of life and general œconomy of the animal determine the structure of less important parts.

" These animals give the true idea of the Amphibia, while all those others which have got this appellation do not in the least deserve the name. This appeared to me long ago to be the case, and therefore I supposed there was not properly any such animal as an Amphibian; for because an animal can dive, and stay, or live a considerable time under water, it is not to be reckoned a bit more amphibious than any other animal, whose stay under water is shorter. The circumstance of being terrestrial or aquatic depends entirely upon the medium in which an animal respires. One of the Tetracoilia can live in water if you will allow it to breathe air, but not otherwise; and the Cetaceous Fish can only stay under water between every inspiration and expiration, as is proved by the Whale, &c.; and a Fish can live out of water, if it is still allowed to breathe water. The animals usually named Amphibious in like manner can only keep under water during the interval between inspiration and expiration; but as their times of respiration are much less frequent than those of the Tetracoilia, whether under water or in the common air, they can of course dive much longer: but an animal to be truly amphibious must have its respiratory apparatus compounded of the pulmonary and branchial organs, which is the case with this tribe, for these only can be said when in the air to be truly terrestrial, and when in the water truly aquatic.

" In the description of any very uncommon animal, in which the parts upon which life immediately depends differ very much from those commonly known, and bear a strong analogy to others which are but very indifferently understood, it becomes necessary to give some idea of the preceding and succeeding links in the general chain of organization, before the connexion of that in question can be distinctly understood. As the animal now before us, therefore, differs remarkably in the circulation of the blood and organs of respiration from all others yet known, our first business is to consider the different forms under which those two essential principles of animal life appear.

" The heart is acknowledged to be the grand organ of the motion of the blood in those animals which have it. In some animals it acts a double part, serving also for digestion *, but these have no connexion with the present subject. Where its use is confined entirely to the circulation, its structure is different, according to the different motions the blood is destined to receive; for in some animals it

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* Mr. Hunter here alludes to the central cavity of the Medusa, &c.

has only one, others two, others three, and the most complete of all four cavities; and this difference of structure forms so many grand divisions of the animal kingdom, which I must be permitted to call by the names of *Monocoilia*, *Dicoilia*, *Tricoilia*, and *Tetracoilia*[*].

"The first order comprehends the animals whose hearts have only one cavity, as is the case in the Insect, therefore they may be called Monocoilia; but as these have no connexion with the present subject, it is sufficient just to mention them.

"The next order of animals to these have but a single circulation, and of course are furnished only with two cavities to the heart, viz. an auricle and ventricle, similar to and answering the same purposes with the right half of the heart in the most perfect animals. To this order belong all the fish with gills; therefore these may be called Dicoilia, in which should be included the present tribe of animals.

"The third order of animals are those commonly called Amphibia: in these the circulation is twofold, although not so distinctly as in the next, because the two circulations become blended in the heart. Their hearts consist of two distinct cavities, which are the two auricles, and of two ventricles; but the ventricles communicate so freely with one another that they are to be considered as only one cavity; therefore these may be called Tricoilia. There the blood from the lungs, and that which has gone through the other parts of the body, mix together, instead of being separated, as in the more perfect animals; so that some of the last sort is thrown back through the body again without passing previously through the lungs, and some of the first sort is pushed a second and perhaps a third time through the lungs, without being first employed in the general circulation.

"The last division comprehends the most perfect animals, which have a double circulation, one through the lungs, the other through the whole body, and for that purpose are furnished with a double heart. The two auricles and two ventricles of which they are composed make up the four cavities by which they are distinguished, and they may be called Tetracoilia.

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[*] These should be written *Monocœla*, *Dicœla*, &c.; but they are spelt as above in the Treatise on the Blood and Inflammation, p. 135, where these names for the Divisions of the Animal Kingdom were first proposed. Like all classifications founded on the variations of a single organ, the cardiac arrangement is too artificial for general application. The Mollusks, for example, are either excluded in this system, or are blended with classes with which they have little or no natural affinity. For Cuvier's Radiated Division of the Invertebrata, Mr. Hunter has elsewhere proposed the term *Acardia*.

"This general account being premised, it is to be now observed, that the tribe of animals before us are an intermediate link between the second and third of the divisions above mentioned, by which they are connected with, or, as it were, run into, each other.

"In order to give as complete an idea of this as our present knowledge of the subject will admit, it is necessary to trace the circulation through these two intermediate classes of animals.

"From the compound ventricle of the heart in the Tricoilia arise three arteries, two of which are anterior, the third posterior. Of the anterior, that to the left hand, which is also the largest, is the pulmonary artery, going to the lungs nearly, as in Man; that to the right hand is the left aorta; and the single posterior artery is the right aorta, which alone gives off the carotids and subclavians. These two aortas make a curvature downwards, descend together along the back, and when got to about the middle of the cavity of the animal, unite into one trunk. This union is similar in some degree to the union of the two arteries coming from the gills in fish.

"This description is taken from the Turtle, and although it may not exactly agree with all of the above class, as the Frog, &c., yet it will in the essentials. Here the lungs and the whole body are evidently supplied from portions of the same mass of blood. But no use appears for the two aortas in this division, and they seem so very superfluous that one might be tempted to suspect they were only provided to lay the foundation of an analogy with the animals of the immediately inferior class, which is the present, and of the class below them, the Fish.

"For in Fish that have only one auricle and one ventricle, the single artery which the heart sends off is immediately distributed to the two sets of gills; from these the blood passes out in two trunks, one on each side, which after running a little way join into one vessel, as the two aortas do in the Turtle; which now runs on as an artery to supply the rest of the body with blood, without having first entered a heart, or what is called the left auricle and ventricle.

"Thus the difference between the two classes is considerable; but Nature, always proceeding by the nicest gradations, has formed two animals which partake so much of the structure of the two classes, that they gently lead us on from the one to the other. The first of these, as being nearest to the amphibious tribe, are the animals now before us*, which, indeed, form the next link in the chain that we are acquainted with, as will be easily seen by comparing them together. The present have but one auricle and one ventricle, sending off one artery, which is common to the gills and lungs, and which might be called pneumobranchial.

" Here is a falling off from the Amphibia of an auricle, and in some measure of a ventricle, notwithstanding which, the effect of the heart upon the blood is nearly the same.

" The artery passes out of the heart, sending off the pulmonary arteries, which are ramified upon the lungs as usual, and then divides into two branches, which are analogous to the two arteries in the Turtle; but as these animals (*Amphiuma* and *Menopoma*) are a degree nearer Fish, these arteries are each again subdivided into two, which afterwards wind round those singular parts—in some measure similar to the gills of Fish,—with which they are furnished. Having made this circuit, the subdivided vessels again unite so far as to form only two trunks, and these two presently join into one in the same manner as we have remarked in Turtle and Fish.

" The other animal—the Siren—completes the gradation by being one remove nearer to Fish: in this the subdivision is not into two branches only, as in that above described, but the whole aorta divides and subdivides into infinite ramifications, similar to the artery in the gills of fish, while the lungs are supplied in the same manner as those of the preceding animal and of the Amphibia.

" Thus the gradation is formed from perfect lungs, first to perfect lungs and imperfect gills, then to perfect lungs and perfect gills, till at last we have no lungs, but simply perfect gills, as in the Fish.

"*Of the circulation in the* '*Chuah Chisstannah, or Craw-fish-eater,*' *or Kattewagoe,* (*Menopoma Alleghaniensis*, HARLAN).

" The most extraordinary thing in this animal is the circulation, with its dependent function, viz. respiration. In this respect it is a mixture of the Fish or Dicoilia, and the Tricoilia, having an opening on each side the neck similar to gills, and lungs similar to those of the Frog. The openings are similar to the gills in fish, yet would seem not to answer any such purpose; for the arteries do not in the least ramify, so as to divide the blood that it might be influenced by respiration through these openings: this is one degree nearer the Tricoilia than the former two (viz. the *Amphiuma*[*] and *Siren*).

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* *Amphiuma didactylum*, Cuv., and *Menopoma Alleghaniensis*, Harlan.

"Like the Fish, it has but one auricle and one ventricle. The auricle is large, and is placed principally on the left side of the ventricle and behind. There is but one artery arising from the heart or ventricle, which at first goes on towards the head, a little contorted, and swells into a considerable bag; then from each side of this bag four vessels go off,—three of pretty considerable size, the other, a very small one. This, which is the first or undermost vessel, passes out laterally, adhering to the œsophagus, giving vessels to it, and being, as it were, spent upon it; but one of its branches is joined by a branch from the second, forming one trunk, which makes the pulmonary artery (Pl. XXIV. *p.*), and which passes down

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[*] The following is Mr. Hunter's description of the circulating and respiratory systems of the *Amphiuma*. See No. 915. "The heart consists of an auricle and ventricle: the auricle is large in proportion to the ventricle, and is placed on the left and upper end, but projecting forward, so that the ventricle is, as it were, sunk in the sulcus of the auricle.

"The aorta arises from the upper part of the ventricle, larger than could be expected in such an animal; it is somewhat contorted, passes up before the œsophagus, and soon dilates into a cavity of nearly the same size as the ventricle. This enlargement is somewhat grooved, so as to look as if made up of different vessels; but on examination it appears to be one bag. It terminates in branches, which are much smaller than the bag from which they arise, and continue diminishing as they pass towards the head: near their origins and posterior surfaces arise two arteries, one on each side, which are reflected downwards to the lungs, and enter them at their upper ends.

"The two trunks diverge a little from one another, as it were, winding round the œsophagus; after which, each divides into two branches of nearly equal size. These two branches on one side, for instance the left, pass outwards to the gills, and there wind round and between the cartilages of those parts, approaching towards the back, then, beginning to converge round the posterior surface of the œsophagus, they pursue their course to the backbone, where both branches unite into one trunk. The single trunk thus formed runs down on the same side of the backbone, attended by a single trunk on the other side, which has passed through exactly the same course. These two, still converging, having run a little way down on the opposite sides of the backbone, and having given off branches to different parts, mount upon that bone, and then unite into one principal trunk, which from this point may be called the descending aorta: this passes down the back, abdomen, and tail, giving in its way vessels to the different parts.

"The inferior vena cava, which collects all the blood from the parts below the heart, is large, and runs through the whole length of the abdomen. At the lower end it lies between the two kidneys;

along the œsophagus between it and the auricle, then gets upon the upper part of the lung, along which it passes and ramifies. The second and third branches, which are the largest, pass outwards, but a little more upwards. They both get upon the upper part of the opening of the gills, then pass along two bones, (which are probably intended as os hyoides, and also for assisting in the dilatation of this passage,) and when they have got to the outer and posterior end the second sends down the branch to join the first as above described, and then they unite into one, there getting upon the upper or posterior surface of the œsophagus, and sending several branches to the head; and when the trunk has got to the middle of the body, behind the œsophagus, it is joined by the corresponding trunk of the other side, which follows the same course. The single vessel thus formed passes downwards between the œsophagus and backbone, giving off vessels to the neighbouring parts; and when it has got as low as the intestines, it sends off the mesenteric artery, which supplies the intestines and liver. The

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but after this it is very loose, running upon the right of the mesentery, to which it is attached by a thin membrane, as also to the back in the same manner. At the lower end of the liver it enters that viscus, passes on, and emerges at the upper end near the heart; then, after proceeding a little way, enters the posterior part of the auricle, having first received the *vena cava hepatica* and the veins from the head, so that only one vein enters the auricle.

"The gills are composed of three cartilages, which are placed in the same manner as gills in fish; but these cartilages have neither the pectinated part nor the mushroom partition which those of fish have: their ends are articulated together, and the whole is joined to the extremity of the same bone as that of the tongue.

"From the fauces there is an opening outwards, between the two inferior cartilages of the gills, for the water to pass. In this opening, which is oblong, is placed a structure composed of two valves, which will obstruct the water passing in from without. The two cartilages which are above the opening, between which the two arteries pass, are lined on the inside by the membrane of the fauces, which is not very thin.

"The lungs are small tubes passing nearly through the whole length of the abdomen, behind and on the inside of the abdominal viscera. Their upper ends are behind the heart, the lower within three inches of the anus; here they become small, and end in a point. They are attached through their whole length by a thin membrane to the root of the mesentery, to the aorta descendens, and, on the right, at the lower end, to the inferior vena cava. The whole of their inner surface is honeycombed: their substance is amazingly vascular, receiving many arteries from the pneumobranchial vessel. The artery passes down all along the anterior edge of the lungs. The vein corresponding to the artery is just such another vessel, and is continued from the lower end of the lung to the upper, as one pretty uniform canal, collecting the small branches in its way, and at length opening into the vena cava a little below the termination of that vein in the heart."—*Hunterian MS. Catalogue.*

main trunk then goes down the back to all the other parts. The fourth or most anterior branch of the bulb of the aorta passes out, gets above the before-mentioned bones, running along the upper edge of the uppermost bone, sends branches to the tongue, &c., gets upon the œsophagus behind, and joins a branch from the united trunk of the other two going up to the head.

" *Of the Veins.*

" The veins set out from the rectum and bladder in two directions, one in front the other behind; the anterior runs along the abdominal muscles to the liver, and is there joined by the other. The other, or posterior vein, runs up the back, receiving the blood from the kidneys, oviducts, &c., passes forwards (sternad) at the upper (atlantal) part of the abdomen, and dips into the liver. The mesenteric vein after having formed the vena portarum, passes also forwards to the lower edge of the liver, and is joined by the anterior vena cava. From the left there are veins running from the stomach, œsophagus, &c., which join the same: all these pass through the liver, and are collected at the upper part, and enter the auricle."

PLATE XXIII.*—*Fig.* 1. The head and anterior part of the trunk of the *Menopoma Alleghaniensis,* dissected to show the heart and lungs *in situ.*

" *a,* The under surface of the mouth.

" *b, b,* The circumference of the mouth.

" *c,* The body of the animal below its fore legs.

" *d, d,* The cut edge of the opening of the upper part of the abdomen, showing the cavity where the heart lies, under the neck and fauces; the skin of the parts turned out.

" *e, e,* The fauces.

" *f,* The division between the cavity which contains the heart and abdomen.

" *g,* The liver.

" *h,* The upper part of the stomach.

" *i, i,* The upper part of the lungs passing through the abdomen.

" *k,* A probe introduced into the lateral or branchial opening which leads to the fauces, which may be observed raising the fauces at *e′*.

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* Nos. 83, 85. *MS. Catalogue of Drawings.* Preparations No. 916, 917.

Fig. 1

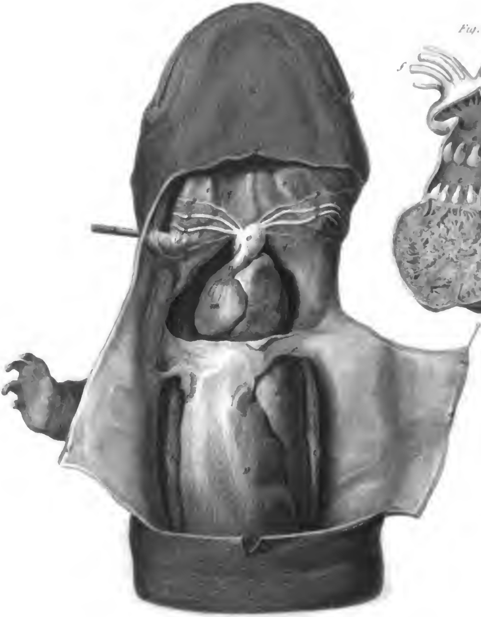


Fig. 2

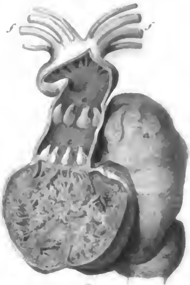
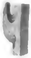
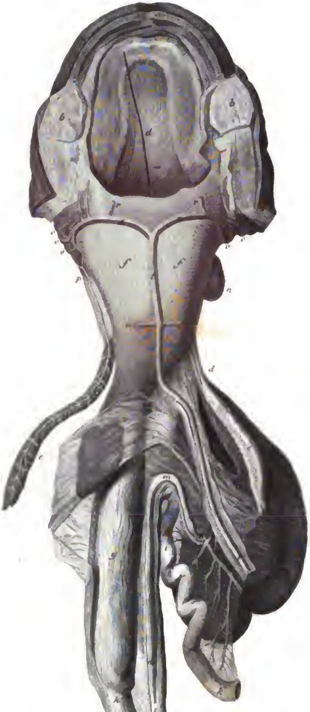


Fig. 3




b
b
d
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e
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" *l*, The auricle.

" *m*, The ventricle.

" *n*, The great artery.

" *o*, A swelling in that artery."—*MS. Catalogue*.

p, *p*, The four branchial arteries given off from the extremity of the bulb.

q, *q*, Branches to common parts, as the head, œsophagus, &c.

Fig. 2. Magnified view of the heart of the *Menopoma Alleghaniensis*, with the ventricle and bulbus arteriosus laid open.

a, The conjoined auricles.

b, The cavity of the ventricle, occupied almost entirely by decussating carneæ columnæ, as in the Tortoise.

c, The orifice by which the carbonized or venous blood enters the ventricle.

d, The orifice by which the decarbonized blood is received from the pulmonary auricle.

e, *e*, The valves of the artery.

f, *f*, The branchial arteries, marked *p*, *p*, in fig. 1.

x, The membranous sinus of the veins of the body.

Fig. 3. A side view of one of the valves of the artery further magnified.

Plate XXIV.* " Is the lower jaw, with the tongue, the fauces, œsophagus, heart, stomach, liver, &c. (of the *Menopoma Alleghaniensis*), looking upon that surface which was in contact with the head and back of the animal, or what would be called a posterior view in the human subject.

" *a*, *a*, Is the upper surface of the lower jaw, upon which may be observed the teeth†.

" *b*, *b*, The masseter muscle cut through.

" *c*, The tongue.

" *d*, A bristle passing into the beginning of the trachea, which is continued down at *d'* into the lung of the right side.

" *e*, *e*, The lungs.

" *f*, *f*, The posterior surface of the fauces and œsophagus.

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* No. 84. *MS. Catalogue of Drawings*.

† Besides the corresponding row of teeth on the upper jaw, there is a parallel row on the fore part of the palate.

" *g*, The stomach.
" *h*, The pylorus.
" *i*, *i*, The duodenum.
" *k*, Part of the jejunum.
" *l*, The posterior surface of the liver.
" *m*, *m*, The ductus communis choledochus.
" *n*, The apex of the heart.
" *o*, *o*, The branchial arteries coming round."
p, The pulmonary artery of the left side.
r, *r*, Cephalic arteries.
" *s*, *s*, The union of these two arteries on each side, on the posterior surface of the fauces.
" *t*, The union of all the vessels from the heart, forming what may be called the aorta descendens."
u, *u*, The brachial arteries.

PLATE XXV.*

"THE BLOOD-VESSELS OF A FOWL," (*Phasianus Gallus*, Linn.).

The description of this figure in the MS. Catalogue is prefaced by the following observations.

" The bones of animals are in general the basis of the animal. They give the lead to the other parts; the muscles, their form, extent, number, &c., in some degree depending on the bones; while the blood-vessels and nerves depend in some degree on both for their course, number, &c.; therefore if there is any difference between the bones of one animal and those of another, the muscles vary accordingly, as also the course of the blood-vessels and nerves.

" But although several orders of animals appear to be very different from others in shape, &c., yet there is almost always an endeavour to reduce them as much as possible to nearly the same principles.

" Although a bird appears to be a very differently constructed animal from a quadruped, yet it is made a good deal upon the same principles. We may ob-

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* No. 86. *MS. Catalogue of Drawings.*

serve that the bones which are the bases of general construction of the animal are a good deal similar; for they may be said to have the same bones, although in some these may be somewhat different in shape, size, &c.; as also there may be some not to be found in any other animals, yet the principles are reducible to those in other animals."

" *The Body.*

" *Fig.* 1. A, A, A, A, The cut ends of the ribs.
" B, B, B, The cut edges of the abdominal muscles.
" C, C, The cut edges of the anus.
" D, The rump.
" E, The last part of the rectum.
" F, F, The two vasa deferentia, with bristles in them, opening into the anus on the points of two small projections.
" G, G, G, The kidneys.
" H, H, The thigh.
" I, The patella.
" K, K, The muscles of the leg.
" *Fig.* 2. K, The muscles of the leg, a continuation of fig. 1.
" L, The metatarsus or foot, commonly called the leg.
" M, M, M, The three toes.
" N, The back toe.
" L*, L*, The neck.
" M*, M*, The trachea.
" N*, The lower œsophagus.
" O, The crop.
" P, P, The first or superior œsophagus.
" Q, Q, The fauces.
" R, The larynx. (Superior larynx.)
" S, The os lingualis.
" T, The wattle.
" U, U, The furculum. (The clavicle.)
" V, The clavicle of one side cut off. (The coracoid bone.)
" W, W, The muscles of the arm.

" x, x, The muscles of the fore arm.

" y, The ligamentum suspensorium alæ.

" *Fig.* 3. z, The continuation of the wing.

" z*, The pinion, or what answers to the metacarpus.

" &, The thumb.

" *The Veins.*

" *Fig.* 1. *a,* The basis of the right auricle, the auricle itself being cut off.

" *b, b,* The two venæ cavæ superiores.

" *c, c, c, c, c,* The two jugular veins; the left of which is wholly exposed.

" *d,* What may be called the guttural or thyroid vein.

" *e,* The lingual, genial, temporal veins, &c.

" *f,* Those coming down from the brain (which anastomose with the vertebral vein).

" *g, g, g,* The veins going from the crop to the right jugular.

" *h.* The subclavian vein.

" *i, i,* The humeral or brachial vein.

" *k, k,* The ulnar vein.

" *l, l,* The radial veins, which are in pairs, one on each side of the artery.

" *Fig.* 3. A continuation of the vessels of the wing.

" *m,* A continuation of ulnar vein.

" *m**, *m**, A continuation of the radial veins.

" *Fig.* 1. (*continued.*)

" *n, n,* Internal thoracic veins.

" *o, o,* Venæ cavæ hepaticæ.

" *p, p,* Vena cava inferior.

" *q, q.* The spermatic veins.

" *r,* What answers to the iliac vein.

" *s, s,* The emulgent veins.

" *t, t,* Femoral vein.

" *u,* The poplitæal vein.

" *v, v,* The posterior tibial.

" *Fig.* 2. *w, w,* A continuation of the posterior tibial vein.

" *Fig.* 1. *x, x,* The veins of the rump and anus.

“ *y*, *y*, The plexus acceleratores seminis.
“ z, The vein common to the vena cava and vena portarum †.
“ z*, z*, The vena portarum.
“ ♂, ♂, ♂, The union of the mesenteric veins into vena portarum.

“ *The Pulmonary Arteries.*

“ I. The common trunk of the pulmonary artery.
“ II. The left branch, going to the lung of the left side.
“ III. The right branch, going to the lung of the right side.

“ *The Aorta and its Branches.*

“ 1, The basis of the left auricle.
“ 2, The end of the aorta as it rises from the ventricle.
“ 3, 3, The common trunks of the right subclavian and right carotid and left subclavian and left carotid.
“ 4, 4, 4, The carotids (which run in close contact with each other along the middle of the neck).
“ 5, The artery going from the left carotid to the crop.
“ 6, The right subclavian.
“ 7, 7, The two right humeral arteries, surrounded by a plexus of veins.
“ 8, The radial artery.
“ 9, May be called ulnar.
“ *Fig.* 3. 10, A continuation of the ulnar artery.
“ *Fig.* 1. 11, The thoracic artery of the right side.
“ 12, The curve of the aorta.
“ 13, The descending aorta.
“ 14, The cœliac artery.
“ 15, The continuation of the descending aorta.
“ 16, 16, The origin of the arteries going to the kidneys and thigh (analogous to the femoral arteries of Mammalia).

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† This vein is in some respects analogous to the inferior mesenteric, since it receives the blood from the rectum and cloaca; but it also transmits to the vena portæ the common blood from the muscles of the tail, and apparently from the posterior lobes of the kidneys by the two veins which are figured, but not named.

"17, 17, The two crural arteries, which send branches into the kidneys (analogous to the internal iliac and ischiatic arteries).
"18, 18, The crural (ischiatic) artery.
"19, The poplitæal artery.
"20, 20, The posterior tibial artery.
"*Fig.* 2. 20, A continuation of the posterior tibial artery.
"21, The anterior tibial artery.
"22, 22, Continuation of the anterior tibial artery.
"23, 23, Ditto.
"24, 25, Divisions of No. 23.
"26, 27, Divisions of No. 22.
"28, Continued from No. 20.
"*Fig.* 1. 29, The common trunk of the artery of the rump, anus, &c.
"30, 30, The artery of the plexus accelerator.
"31. The artery of the rump, anus," &c.—*Hunterian MS. Catalogue.*

PLATE XXVI.*

RESPIRATORY ORGANS OF AN OSTRICH.

"As the lungs of birds adhere to the parts they are in contact with, they cannot be said to have a cavity forming the chest; and of course cannot be said to have a membrane called the pleura, nor a distinct muscle called a diaphragm. Yet they have what answers the purpose of a diaphragm, which adheres to the whole under surface of the lungs; and, as it adheres to the lungs, it is only muscular on its outer edge, and there only in distinct parcels, which when they act, will pull the lungs down by straightening, as it were, this surface of adhesion to the lungs.

"As the lungs open on their external surface in a vast number of places, so as to let the air escape from their cells into different parts of the body, particularly the abdomen, they may be said to be only opening a passage for the air into those parts. The lower plane or surface made by the diaphragm is not so transverse as in the quadruped.

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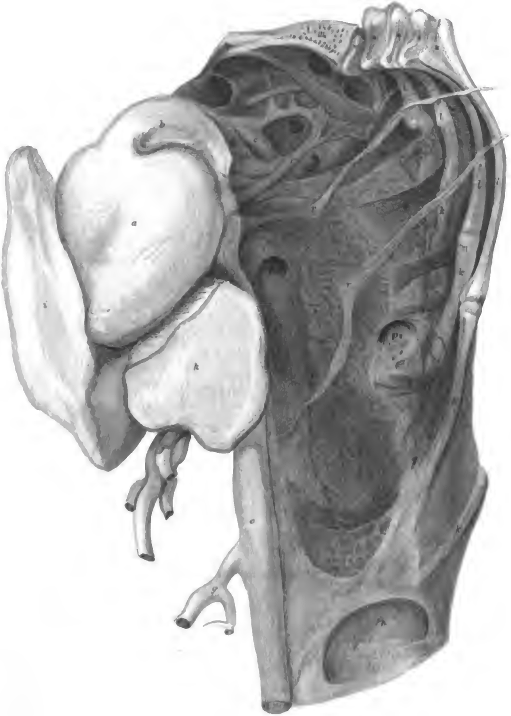
* No. 95. *MS. Catalogue of Drawings.*

Pl. XXVI



" This drawing is a view of the left side of the diaphragm of a young Ostrich having the sternum removed. The plane of its lower surface reached from the lower edge of the lungs below and behind, just above the head of the kidneys to the upper part of the chest above and forwards.

" The heart is in its situation covered by the pericardium. The left lobe of the liver is cut off to expose the left side ; only the right lobe is in its place. It shows the attachment to the lungs of the partitions of the abdominal air-cells : between each partition is the opening from the lungs.

" *a*, The heart.

" *b*, The vessels going out from the heart.

" *c*, The pulmonary artery.

" *d*, The descending aorta.

" *e*, The aorta in the abdomen.

"*f*, The artery of the stomach.

" *g*, The mesenteric artery.

" *h*, The surface from which the left lobe of the liver was cut off.

" *i*, The left side of the right lobe of the liver.

" *k*, *k*, The ribs. (The dorsal portions.)

" *l*, *l*, The ends of five ribs that were articulated with the sternum. (* * The articular ends of these sternal ribs.)

" *m*, Part of the sternum cut through.

" *n*, The head of the kidney.

" *o*, *o*, The lower and anterior surface of the lungs, covered with what may be called diaphragm.

" *p*, *p*, The openings from the lungs into the abdomen and chest.

" *q*, *q*, The muscular portions of the diaphragm arising from the ribs, and inserted into the membrane covering the surface of the lungs.

" *r*, *r*, The attachment to the lungs of three partitions of air-cells in the abdomen."—*MS. Catalogue.*

PLATE XXVII.*

AIR-CELLS OF THE LUNGS IN MAMMALIA.

" *Fig.* 1. A part of the lung of a Lion, magnified to show the manner of ramification of the trachea, and its termination into cells; with the mode of division of one cell into many.

" *a, a,* Are branches of the trachea passing through the lung, and giving off branches similar to an artery; but at last giving off cellular branches.

" *b, b,* Are the mouths of some of these cellular branches.

" *c, c,* Are the cellular branches going off from the trunk. The rest is the general cellular substance in which it may be observed that each cell is again dividing into others.

" *Fig.* 2. Is a slice of the lung of a Porpesse, which is principally to show that the cartilages of the trachea are continued through the smallest branches; but not with that regularity which is in the trunk or trachea itself.

" *a, a,* Are the branches of the trachea in which the cartilages are represented.

" *Of the Lungs of the Whale Tribe.*

" The lungs are two oblong bodies, one on each side of the chest, and are not divided into smaller lobes, as in the human subject. They are of considerable length, but not so deep between the fore and back part, as in the quadruped, from the heart being broad, flat, and of itself filling up the fore part of the chest. They pass further down on the back part than in the quadruped, by which their size is increased, and rise higher up in the chest than the entrance of the vessels, coming to a point at the upper end. From the entrance of the vessels they are connected downwards, along their whole inner edge, by a strong attachment (in which there are some lymphatic glands) to the posterior mediastinum. The lungs are extremely elastic in their substance, even so much so as to squeeze out any air that may be thrown into them, and to become almost at once a solid mass, having a good deal the appearance, consistence, and feel of an ox's spleen. The branches of the bronchiæ which ramify in the lungs have not the cartilages flat, but rather rounded; a construction which admits of greater motion between each.

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* No. 96. *MS. Catalogue of Drawings.*

Fig 1.

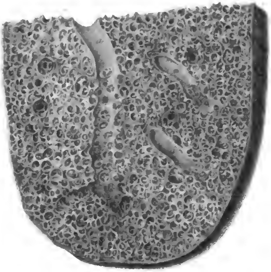


Fig 2

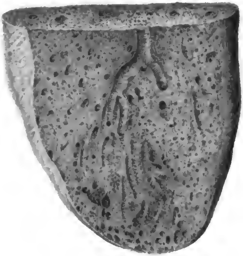


Fig. 1

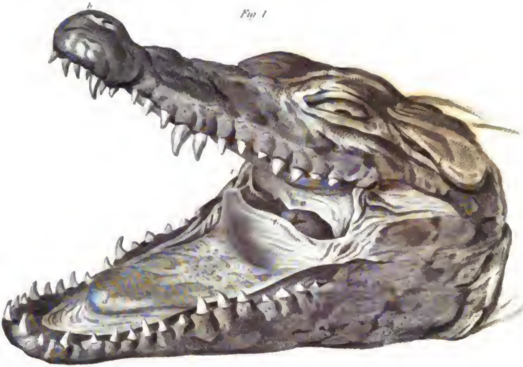


Fig. 2

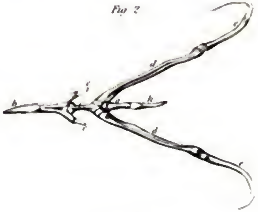
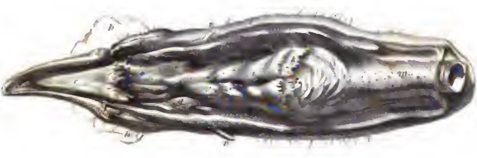


Fig. 3



T. Bradley

" The pulmonary cells are smaller than in quadrupeds, which may make less air necessary, and they communicate with each other, which those of the quadruped do not; for by blowing into one branch of the trachea, not only the part to which it immediately goes, but the whole lung is filled."—*Hunter, On Whales, Phil. Trans.* lxvii. (1787) p. 418.

PLATE XXVIII.

LARYNX, FAUCES, &c., IN OVIPAROUS VERTEBRATA.

Fig. 1.* The head of a young Crocodile (*Crocodilus acutus*, Cuvier), with the jaws separated to show the mechanism by which the communication between the mouth and fauces is closed, and the apertures of the larynx and pharynx defended both against the insects and other parasitic animals which gain admittance to the mouth from its being unprotected by lips, and also against the entry of water during the period when the Crocodile holds submerged a living and struggling prey.

a, The head.

b, The protuberance at the end of the upper jaw on which the nostrils are placed.

c, The lower jaw.

d, The end of the tongue raised by pressure from below: it is closely connected to the rami of the jaw by a continuation of the membrane of the mouth.

e, The glandular part of the tongue.

f, The transverse ridge formed by the expanded cartilaginous body of the os hyoides, which raises a corresponding fold of the membrane of the mouth.

g, The soft palate, against which the preceding cartilage and fold are applied, which makes the septum between the mouth and fauces complete.

h, The prominence formed by the larynx, showing its longitudinal linear aperture.

i, The orifice leading to a cavity formed by a duplicature of the lining membrane of the fauces, which covers the opposed cartilaginous surfaces of the descending pterygoid process and ramus of the lower jaw, where it assumes the texture of synovial membrane.

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* No. 91. *MS. Catalogue of Drawings.*

k, The flap covering the *membrana tympani*.

Fig. 2.* The os hyoides of a Pea-fowl (*Numida Meleagris*, Linn.).

" The os lingualis and ossa laryngis.

" *a*, Os lingualis (*Glosso-hyal*, Geoffroy †).

" *b*, Cartilage on the end of the os lingualis.

" *c*, *c*, Cartilages on the ends of the two processes of the above bone.

" *d*, Ossa laryngis prima (*Apo-hyals*, Geoffroy).

" *e*, *e*, Ossa laryngis secunda (*Cerato-hyals*, Geoffroy).

" *f*, Os commune, or bone common to the os lingualis and os laryngis (*Basi-hyal*, Geoffroy).

" *g*, A small bone placed on the os commune (*Uro-hyal*, Geoffroy).

" *h*, A cartilage on the end of the preceding.

" *Fig*. 3.‡ Is the lower jaw, with the tongue and larynx of a Cock.

" *a*, The hollow of the inner surface of the under jaw.

" *b*, An outline of the wattles.

" *c*, The tongue, ending at the base in little rough pyramidal processes.

" *d*, *d*, The angle made by the union of the two mandibles.

" *e*, *e*, The lower jaw behind the angle, just as it was when cut through; and, as it were, continued into the skin of the neck at *f*, *f*.

" *g*, *g*, The fauces on each side of the tongue and larynx, marked with innumerable orifices of the ducts of small glands.

" *h*, Indicates the situation of a muscle which passes between the thyroid cartilage and tongue.

" *i*, The opening of the larynx.

" *k*, Is placed upon two rows of pyramidal bodies, whose points are turned backwards.

" *l*, The cut end of the trachea, which raises the œsophagus.

" *m*, The œsophagus.

" *n*, *n*, Parts of the ossa laryngis (*Cerato-hyals*, Geoffroy) cut through."

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* No. 89. *MS. Catalogue of Drawings.*

† *Philosophie Anatomique*, p. 148. pl. 4.

‡ No. 90. *MS. Catalogue of Drawings.*

Fig. 1

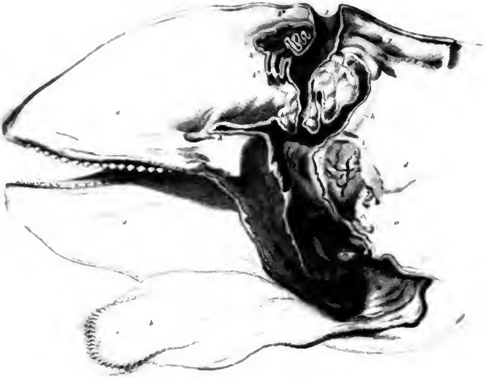

Fig. 2.

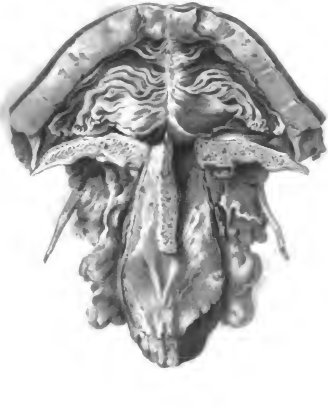

PLATE XXIX.

“ This contains different views of those parts of the Porpesse that are concerned in breathing, or what may be called the nose.

“ *Fig.* 1.[*] Is a side view of the inside of the nose. The head is divided as far back as the skull, nearly in the middle, but not exactly so, the septum nasi being left entire in this section.

“ *a, a,* The cut surfaces of the upper and lower jaws.

“ *b,* The tongue fallen to one side.

“ *c, c,* The cut surface of the os palati.

“ *c',* The palatum molle. *d,* The skull.

“ *e,* The skin and fat on the upper part of the head.

“ *f,* A small part of the brain, exposed. *g,* The septum narium.

“ *h, h, h,* The different cavities or processes of the nose.

“ *i, i,* The direct passage of the nose. *j,* The external opening.

“ *k*, *k'*, *k''*, *k**, What answers to the turbinated bones in other animals. (The plicated processes here represented are not supported by bone; they are of a muscular and adipose texture, covered by a thick dark-coloured cuticle, which from its hard insensible nature is well adapted to protect the nasal passages against the irritation to which ordinary pituitary membrane would be subjected by the currents of sea-water continually ejected from the nose.)

“ *m,* The projecting part of the larynx or glottis.

“ *n,* The membrane of the fauces covering the side of the larynx.

“ *o,* The passage leading into the other nostril.

“ *Fig.* 2.[†] Is a view of the anterior surface of the nose, looking from behind, the head being sawn across.

“ *a, a,* The skin and fat on the upper part of the head.

“ *b, b,* The bones of the head. *c,* The septum narium.

“ *d,* That part of the cavity of the posterior nostril which the projecting part of the larynx lies in.

“ *e, e,* The same cavity divided by the septum.

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[*] No. 101. *MS. Catalogue of Drawings.*

[†] No. 102. *Ibid.*

"*f*, Two swellings, the side view of which is seen at *k*′, fig. 1.

"*g*, *g*, Convolutions of plates seen at *k*″, fig. 1.

"*h*, Similar convolutions seen at *k**, fig. 1.

"*i*, The external passage.

"*k*, *k*, *k*, &c., Includes the whole extent of the cavity of the nose."

(From the yielding nature of the tissue supporting the corrugated membranes *k*′, *k*″, these can be distended and unfolded by the pressure of water forced up from below; they then assume an oval figure, capable of holding a quantity of fluid, which, by the action of the surrounding muscular fibres, is forcibly ejected from the blow-hole.)

PLATE XXX.†

" The tongue, larynx, posterior nares, &c., of the Porpesse, taken out of the head and exposed.

"*a*, The upper surface of the tongue, pointing by two dotted lines to two small pieces of wood, which are continuations of *h*, *h*.

"*b*, The palatum molle, with part of the roof of the mouth.

"*c*, *c*, The common beginning of the posterior nares, in which the glottis lies.

"*d*, *d*, A ridge which forms the mouth of the posterior nares, which is a muscle of the sphincter kind, and which I call constrictor narium.

"*e*, The mouth of the glottis, which is within the nares, and grasped by the constrictor.

"*f*, The projecting part of the larynx lying in the fauces.

"*g*, *g*, The inner surface of the pharynx, it being slit open and turned aside.

"*h*, *h*, Two slips of wood lying in the pharynx, passing forwards one on each side of the glottis; continued under the palatum molle, and appearing forward on the tongue at *a*.

"*i*, *i*, The ends of the os hyoides."—*MS. Catalogue*.

For a further description of the above apparatus, see p. 105 of the present volume.

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† No. 103. *MS. Catalogue of Drawings*. Preparation No. 1169.